APRIL 1963
UNITED STATES ARMY
AVIATION DIGEST
ARMY
ARMY
ARMY
ARMY

UNITED STATES ARMY AVIATION DIGEST

APRIL 1963 VOLUME 9 NUMBER 4

DIRECTOR OF ARMY AVIATION, ODCSOPS
DEPARTMENT OF THE ARMY
Col Robert H. Schulz

COMMANDANT, U. S. ARMY AVIATION SCHOOL
Brig Gen Robert R. Williams

ASST COMDT, U. S. ARMY AVIATION SCHOOL
Col Warren R. Williams

EDITORIAL STAFF

Capt Richard C. Anglin
Fred M. Montgomery
Richard K. Tierney
William H. Smith
M/Sgt Thomas M. Lang
Diana G. Williams

USABAAR EDUCATION AND LITERATURE DIV

Pierce L. Wiggin
William E. Carter
James E. Coleman

CONTENTS

LETTERS 1

HUMAN STRESS, Capt Donald Ice 3

TECHNIQUE OF SCANNING 6

ANNUAL WRITTEN EXAMINATIONS, Capt Charles W. Emrick 7

THE AVIATION COMBAT DEVELOPMENTS AGENCY,
Lt Col Morris G. Rawlings 9

A CREWCHIEF SPEAKS OUT 12

OPEN MINDS 14

TORQUE, Capt Jerry A. Simmons 17

MAINTENANCE OFFICER, Capt Jack W. Serig 19

THE AERIAL ESCORT PLATOON (PROPOSED), Capt Henry W. Meetze.. 21

ARMY IROQUOIS AIRLIFTS 36, Joseph Micci and John Vitter 24

TWX 26

LAMENT ON LUBRICATION, Capt Ralph J. Ritchie 28

ENGINE OIL, Lt Harry D. Hunter 32

FIRE SUPPORT PLANNING, Lt Col Edward B. Blackman 36

CRASH SENSE 41

Cover: The Army's newest aircraft, the CH-47A Chinook, currently is undergoing user tests by the U. S. Army Aviation Board at Fort Rucker, Ala. The CH-47A has a maximum payload of over 7 tons.

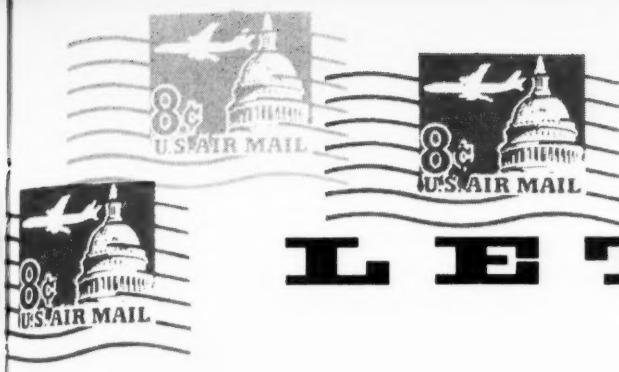
The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted giving credit to the DIGEST and to the author, unless otherwise indicated.

Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U. S. Army Aviation Digest, Fort Rucker, Alabama.*

Use of funds for printing of this publication has been approved by Headquarters, Department of the Army, 27 November 1961.

To be distributed in accordance with requirements stated in DA Form 12.



LETTERS

Sir:

Reference "Why Always the Pilot," December issue of the AVIATION DIGEST.

This author probably had good intentions, but some of his statements are inaccurate. Some examples with comments are as follows:

"Too frequently an atmosphere of hang the pilot seems to affect flying evaluation boards investigating Army Aviation accidents."

This infers that flying evaluation boards investigate all accidents and that all investigating boards are trying to hang the pilot. This is not true. This author should know the difference between a flying evaluation board and an aircraft accident investigating board, since he was a student at USC at time of authorship.

"The pilots rebuttal, . . . was upheld by USABAAR and he was cleared of the charge of poor judgment."

This infers that USABAAR has the authority to clear an individual of a charge. To my knowledge, this is not true. USABAAR answered the pilot's rebuttal with school policy and published an article in the May [1962] issue of the AVIATION DIGEST.

"The Board . . . . It is difficult to believe that their thoughts were not the same as many other persons associated with aircraft accident investigation boards. The pilot will be blamed. The only variance will be the degree of guilt."

I believe that few, if any, aircraft accident investigators have this thought.

FERMAN E. STEWART
Major, Arty
USABAAR

● *Yes, we goofed—we missed this point through editing, review, and processing.*

Sir:

The December issue of AVIATION DIGEST was highly informative and interesting as per usual. One of the most interesting articles in this issue concerned the pros and cons of autorotations.

I have one suggestion that might help make the next issue a bit better. In your December issue on page 18 where the TWX excerpts are printed along with drawings of Army aircraft, there seems to be one thing missing. This is the new designation given to Army aircraft. I am familiar with some of them, but to help all aviators become familiar with all of them, could you print the designation of each aircraft under its drawing so that quick reference could be made back to them when reading the crash excerpts?

You see I am in the armed HU-1—or I mean UH-1—unit in Vietnam. Here we are sometimes a little behind in keeping up with the new designations.

I hope this addition will be possible in your next issue.

HERBERT C. DAMRON
Captain, TC
APO 143
San Francisco, Calif.

● *Suggestions from our readers for improving the DIGEST are always welcome. When feasible such changes will be incorporated.* *(See page 26.)*

Sir:

I served in the Naval Aviation Safety Center, Norfolk, Va., as an aircraft accident analyst during 1954-1956 and was aware of initial Army efforts to establish an Army Aviation safety program. Your publication, U. S. ARMY AVIATION DIGEST, is a credit to the efforts of the staff to further aviation safety.

As a member of the military staff assigned to the Federal Aviation Agency and attached to the Safety Evaluation Division of Flight Standards Service, I have had occasion to review aviation safety literature published by the individual members of the Armed Forces, in addition to reviewing the various aviation journals published for civilian aviation. From my observation, the Armed Forces safety magazines do much the better job in enlisting the aid of the pilot in furthering aviation safety.

During my present assignment it has been my painful duty to review military flight violations filed against military pilots. Some of them just should not have happened. . . .

It has been my observation that the aviation safety programs of the individual armed services, as reflected in their aviation safety publications, have not made the maximum contribution in focusing the pilot's attention and the attention of all responsible aviation personnel on the serious consequences of continued violations of the air traffic rules by military pilots.

FRANK L. DANOWSKI
Commander, U.S. Navy

Sir:

I was intensely interested in Lt Hendrickson's article on cold weather in the December DIGEST. At the time it arrived I had a general officer, a U-6A, and some well below zero weather to contend with. He [Hendrickson] gave some specifics I was unable to find elsewhere, and is quite correct in stating that the school is rather deficient in such instruction. Very little shows up in the -1 either.

I'm getting in quite a bit of time in connection with my job here in the Guard and have become acquainted with a few other items they never told us about at the school. Being out by yourself, 300 miles from any support, puts most of this liberal education on a do-it-yourself basis. I have found quite a bit in the back issues of the DIGEST pertinent to some of the problems encountered.

Thanks very much!

ALAN W. BOURNE
Capt, Arty, Wyo ARNG

Sir:

Reference your article "Safety in the Centuries." [DIGEST, January 1963.]

I am in full agreement with the written portion and spirit of the article; however, I believe the pictures are perfect examples of things an alert safety officer should pick up and emphasize.

Boots or shoes and socks should not be removed when going into the water and you are equipped with a life vest or water wings. Not only do white feet dangling in the water attract sharks—why throw away one of your best pieces of survival gear in case you should reach shore and have to walk home? The same goes for head gear such as a helmet. This can be used to protect the head and to catch good drinking water when the sky pours forth.

The arrival of a helicopter on the scene does not necessarily mean rescue. Many a trooper has had a surprise fall back into the water from a rescue sling, and in case you do, the good set of water wings which you go into the water with can prove invaluable in saving your life. It's a simple matter to get into a sling with the underarm type water wings.

Friend #6 in the last picture is about to be in for a rude awakening if he is simulating an actual jump into the water. First, with feet spread apart prior to entry into the water and with boots removed, he is going to wish he had kept his feet and legs closed—for obvious reasons. Secondly, with arms down at his side and not folded across the water wings in the front, he is most probably going to have at least a bloody nose as the front of the wings pop up into his face.

It may be a matter of personal preference, but to me it's a good idea to unsnap the safety guard on the canopy release prior to entry into the water, then it will be a simple matter to spill the canopy. There are, however, many different types of these releases in service so this will depend on the type you are equipped with. In case you do pull down the guard, be sure and push it back into position prior to climbing into a liferaft because it could puncture the raft or water wings.

Survival goes hand in hand with safety. It is of little value if we provide our troops with all the safety gear possible and then have them perish after they have safely escaped an airplane in trouble.

JOHN T. STANFIELD
Major, TC
USAAVNS

• *Kudos to Major Stanfield for his sharp eye and his excellent survival tips. For economy, full gear was not employed and trainees wore obsolete flying suits. They were lowered gently into the water and towed behind the boat to practice harness release and dinghy boarding in the water. Instructors and crewmen in other boats kept a careful watch for stray sharks.*

Sir:

Reference January 63 issue, Capt Malone's piggyback chopper transport overlooks overhead wires, underpasses, bridge trusses, trees, etc. A stake and platform flatbed truck (or a flatbed trailer) as used for some years by the Mississippi National Guard will give the chopper better overhead clearance; also, the chopper should be carried tail forward.

H. G. FULLER, LT COL, CE
Area Engr
Goose Bay, Labrador

Always present in flight, human stress sometimes impairs the pilot's ability to rationalize—to let facts rather than opinion govern his decisions when faced with a crisis.

Human Stress

Captain Donald Ice

ASK ANY AVIATOR what his aircraft can do and he will be quick to respond with velocities and distances. In the discussion you may note that the limitations are all confined to the machine rather than the man. Of course he has limitations, too, but these are shaded areas that are hard to define. Yet we know they exist and vary between individuals. In fact, they may even vary in the same individual at different times.

The machines we fly are inanimate objects and are, therefore, incapable of making mistakes by themselves. But add one living, breathing, and perhaps even thinking homo sapiens and immediately we have an accident potential. The reason for this is clear. While men, like machines, are governed by the laws of nature, they are also affected by emotional factors. These appear to the individual experiencing them in the form of physical stress.

There is also a certain amount of inertia in every situation that tends to increase the stress. Normally, these stresses are small and the individual remains in a state of equilibrium. But when such environmental pressures as urgency, social opinion, weather, fatigue, fear, mechanical failure, or just plain get-home-itis occur, this equilibrium is disturbed and stress begins to increase. When we stress a piece of metal structure past its elastic limit, it begins to elongate and strain until we exceed its ultimate strength, and fracture quickly follows. This is essentially what happens in an individual under stress. There is a marked reduction in efficiency with each application of stress beyond the individual's rational limits.

The limits to human rationality are skill, knowledge and ability. A person can increase his skill level by training or his knowledge by understanding, but he cannot change his ability because this he inherits from his ancestors. The importance of these limits can be seen when it is realized that they establish human capabilities and limitations. If we want this data on the machines we fly, we merely refer to the flight handbook. But the psychologists have not yet reached the point where they can write a handbook on an individual. First of all, human skill and knowledge are continuously changing through a complex process of learning and forgetting. Second, too many variations exist between individuals, and this is why psychologists can only describe the normal. Yet the capabilities of both the machine and the man must be considered and matched in performing a mission. Since those of the inanimate machine are well known, here we need only concern ourselves with the limits of the Army Aviator.

It is a somewhat curious, though obvious, fact that stresses are multiple. Most aviators have heard the classical example of small errors developing into larger ones that typify so many flying accidents. This pattern of multiple cumulative stress can be found in almost all accidents where pilot error is involved.

When an Army Aviator tells you the limitations of his air-

Capt Ice wrote this article while a student in the Aviation Safety Division, University of Southern California. He is dual rated with approximately 2400 hours flight time.

craft, he is either right or wrong. For verification of his knowledge we can again consult the flight handbook for empirically derived factual information. But when he expounds on his own capabilities, his statements are largely opinion. We have all heard this type of chatter: "I can set it down anywhere," and "I can fly the crate it came in." Such statements are neither true nor false; they are the transitive opinions of the person making them. For this reason they should be completely discounted in rational decision making.

In August 1959, I was a passenger on a CH-21 going into the Cascade Mountains north of Lake Chelan in Washington State to investigate and recover bodies from a U-6 accident. Missing since the previous January, the U-6 had been found by a fisherman and his son a few days before our flight. It had been lost while crossing the mountains at 12,000 feet on top of a solid cloud layer and flying into a 70-knot quartering headwind. But now, finally, we knew where it was—100 nautical miles north of its intended course and at an elevation of 6,000 feet. It had run into the side of a mountain.

On my way to Wenatchee airport to join the rest of the investigation team, I flew a U-8 over the wreckage. It was some of the roughest terrain I had ever seen and as I went on to Wenatchee I could visualize a 3-day hike just getting to it.

Upon joining the rest of the team I was greatly astonished to find that a CH-21 pilot had already flown over the crash site and had convinced the unrated investigating board president that he could land. The aviator's statement at that time was, "All I need to land is a clearing of 50 by 100 feet."

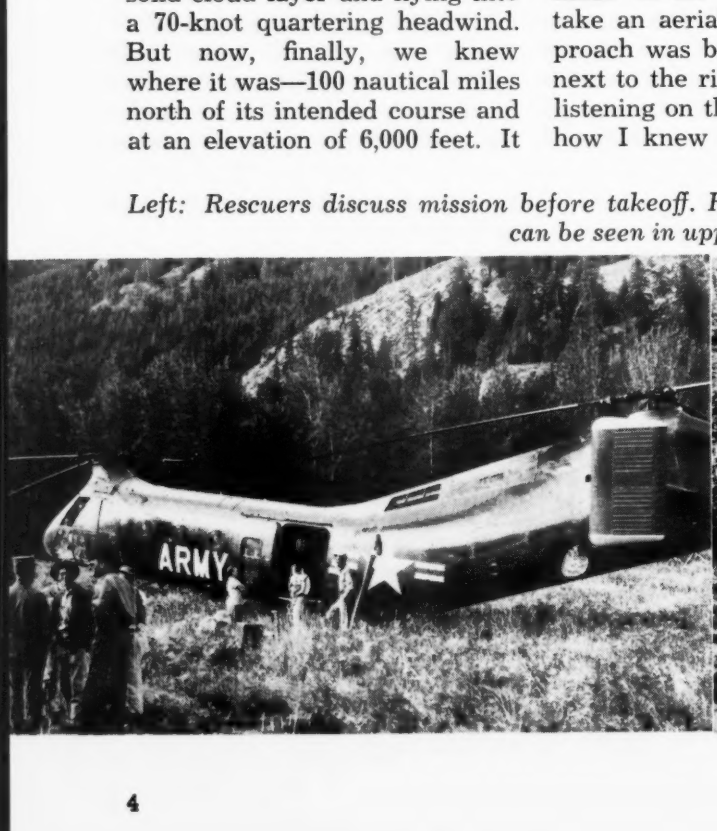
The last hour of our flight to the wreckage was through winding valleys of tall fir trees until we reached the top of the treeline, and then we picked our way between rocky crags at about 8,000 feet. Finally, we spotted the wreckage and a small clearing about 100 yards down the slope. One circle was made to let the photographer take an aerial shot, and an approach was begun. I was sitting next to the right front door and listening on the intercom. Somehow I knew we couldn't make it but we had passed the point of discussion so I just got a good grip on the overhead.

As the pilot began his landing flare I heard him say, "I can't slow it up." The ship began to struggle for altitude as we passed the clearing. Suddenly, there were trees on both sides of the ship and, when I glanced forward through the cockpit, I could see the bubble moving laterally back and forth across the slope, as though the chopper sensed its peril. The impact was sharp but I didn't lose my grip. We rolled over and started sliding downhill and I was sure that the gas tank would rupture and explode with each successive jolt. Finally, it was over and no one was seriously hurt.

Five days and many complications later, we had finished the wreckage portion of the U-6 investigation and moved the bodies down to the 5,000-foot elevation where we were to be picked up by another CH-21.

The pickup point was a large sloping meadow and the CH-21 seemed to have no trouble landing. But the weather was closing in and the pilot elected to take all of us and the bodies out in one trip. This time the statement

Left: Rescuers discuss mission before takeoff. Right: Aircraft after accident. Proposed landing point can be seen in upper left corner of photo.



Walking out of box canyon where first crash occurred

was, "If it will hover with 48 inches, I can take off." So we loaded up and it hovered, but I couldn't see the power settings. We started downhill across the meadow and began to slowly climb over the tall fir trees at the lower end. The first indication I had of trouble was a slow turn to the left. The forward speed began to fall off as the pilot attempted to inch the ship back into the meadow. As the forward motion stopped, we began to settle into the trees under full power. When the blades separated, the engine and drive shafting whined crazily. The initial ground contact seemed harder than the previous crash but at least the ship stayed upright.

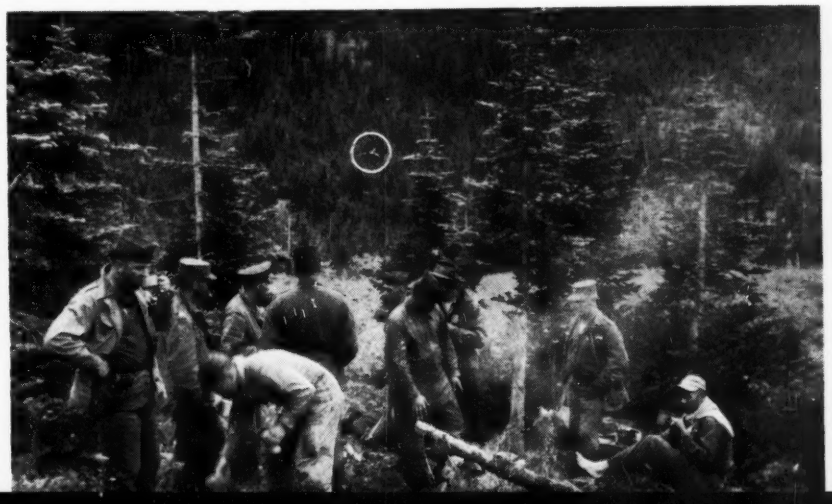
With the help of the forest service and two unfriendly mules we walked back to the upper edge of Lake Chelan. Twenty-five more miles down the lake by boat and we were out.

All three of these accidents were directly attributable to pilot error. But now I have had a few years to think them over and in my view they go much deeper than that inclusive classification. In completing his mission, each of these men pushed his machine beyond its capabilities. Yet we know that they were all skilled in their aircraft and should have known its limitations. Therefore, this analysis leads to the conclusion that, in all three cases, it was the rational limits of the pilots that were exceeded. They were unable to correctly evaluate the consequences of the alternative solutions because they allowed their opinions to govern their decisions instead of the facts. Their ability to rationalize had been impaired by stress.

We need not be concerned here with isolating the multiple stresses underlying each of these accidents. It should be sufficient to point out that the stress in these situations did exist before the accidents and did cause the faulty decisions that resulted in pilot errors.

If there is anything to be learned from these accidents, it is that stress is always present in flight. If the Army Aviator realizes this, he makes his decisions based on all the facts available and eliminates his opinion from consideration. The pilot can change the course of his decisions at many points in a flight. The 180° turn is the best example. But with each failure to face the facts, the stress to prove an opinion true becomes greater and greater until, in the end, the cumulative effect results in a rapidly deteriorating situation, an accident, and the probability of injury or death.

Rescuers pause after crash of second CH-21 in background



Technique of Scanning

TO MAINTAIN AN efficient search in all parts of the relatively large area of sky over which a pilot must divide his attention, the use of a methodical scanning technique is essential. The basic requirement of a good scanning pattern is that it should cover the areas as frequently as possible, without becoming coarse enough to increase the danger of overlooking an object within visual range.

The observer must decide how large an area he intends to cover and how far away he hopes to make visual contact in any given direction under the existing conditions of illumination. It is important to avoid fatigue and waste of effort in trying to scan an area which is beyond the maximum visual acuity of which the eye is capable. Once the extent of the area has been decided upon, the pilot/observer should adopt a simple geometric pattern of scanning which will cover the area in such a way as to make the best use of the off-center vision of night nerves. A trained observer (or pilot) should know his own optimum scanning technique.

On the assumption that the average person sees best at an off-center angle of 6 to 10 degrees, the line of sight should be moved in steps of 10 degrees each, since this will insure an overlap between adjacent fields of maximum visual acuity at each successive point of fixation. It is largely a matter of personal choice whether one scans in the same way as one would read a book or in the "S" pattern, in which the horizontal direction of scan is alternately left to right, and right to left.

S-TYPE SCAN

If one is forced to recommend a single type in preference to all others, the S-type scan probably would be chosen. In this technique, the pilot or observer scans along a horizontal line near the top of the visible area, moving the head and eyes slowly from one point of rest to another, the distance between successive rest points being about 10 degrees, and the duration of each pause 1 or 2 seconds.

At the end of each horizontal sweep, the line of sight is depressed or dropped 10 to 15 degrees, and the same pattern is repeated but in the opposite direction to the previous horizontal line. In this way a relatively large field of view can be covered in 10 to 30 seconds, depending on the speed of the scanning. The choice of scanning speed depends on the existing circumstances, which may call for careful coverage at the expense of speed, or for frequent sweeps with some sacrifice of accuracy. (From NAVMED P-5006 "Naval Aviation Night Vision Instructor's Manual.")

(To retain night vision, when using a flashlight in the cockpit, keep one eye closed. The closed eye will retain night vision; same procedure applies for lightning—FSF Bulletin)

Words of wisdom, circa 1814

Careful Planning Pays Off

"To your discretion, therefore, must be left the degree you may risk and the point at which you decline, only saying, we wish you to err on the side of your safety and to bring back your party, even if it be with less information."

This was the charge given Capt Meriwether Lewis and Lt William Clark, U. S. Army, by President Thomas Jefferson. Lewis and Clark were about to set out on their famous expedition. Before it was over, Lewis and Clark covered nearly 4,000 miles of unexplored country, encountered various Indian tribes never before seen by whites, made valuable scientific collections and observations, and were the first explorers to reach the Pacific by crossing the continent north of Mexico.

How well did they observe the safety admonitions of President Jefferson? In spite of exposure, hardship and peril, only one member of the party lost his life and that was by sickness, not by accident. One hundred and fifty-nine years ago, Lewis and Clark made careful planning and execution pay off. Army Aviators can do the same today.

A good review of our professional knowledge is the purpose of the Army Aviation

Annual Written Examination

Captain Charles W. Emrick

TO MANY ARMY Aviators, the annual written examination is just another requirement, a requirement that along with the annual trip to the flight surgeon ensures the extra monthly income. This is not the intent of the examination, and perhaps the term itself should be annual *review*.

Once the student receives his wings and departs Fort Rucker, formal schooling becomes a thing of the past. Of course, there are subsequent transitions and courses, but the basic fundamentals are gained during initial flight training. The annual written examination is intended as a review to ensure that the basic fundamentals and regulations are retained. These fundamentals are necessary for safe pursuit of daily operations.

Few realize the tremendous effort put into the annual examination and study guide. Work begins in April of each year for the next year's exam, that is work on the '64 exam begins this month. Careful analysis is made of the past year's exams to determine areas that need be explored. In addition, each questionnaire from the previous year's exam is read and given consideration. Almost 1,200 such questionnaires were received with the '62 exam answer cards. All aviators are encouraged to use the questionnaire, which is provided with each examination, to state reasons for recommended changes to the examination. This is our exam, so speak out if there are areas that you feel should be changed. If a change is in order, it will be made!

The annual written examination is prepared by the Flight Inspection Branch, Standards Division, Office of the Director of Instruction at Fort Rucker.

When all of the answer cards from the past year's exam are received at Fort Rucker, the work of analysis begins. Each version of the exam is analyzed to determine the difficulty level, average score, number of failures, etc. When the analysis is complete, work begins in making necessary changes and rewriting questions for the next year's exam. In September of each year a pretest is conducted at Fort Rucker to determine the exam suitability. A cross section of volunteers, fixed wing and rotary wing rated, instrument and noninstrument rated, take each version of the exam. As a result of the pretest data, changes are made to ensure desired difficulty levels and deletion of undesirable questions. The exam must be ready for distribution the first of each year. As the completed copies of the exam are going out, tentative work begins on the next year's exam.

Numerous aviators fail to indicate their rating, aircraft qualifications, and other requested data on their answer cards. All aviators are requested to please supply this data on future exams so that analysis here at Fort Rucker can be complete. *Of the 7,300 answer cards received from the 1962 exam, nearly 1,000 aviators did not supply this information.*

Capt Emrick is the Training Analysis Officer, Standards Division, DOI, at USAAVNS. He is dual rated with approximately 1200 flight hours.

The following data, taken from the 1962 annual written examination answer cards, is published in answer to numerous inquiries.

AIRCRAFT QUALIFICATIONS

	Aviator	*Senior Aviator*	*Master Aviator*
O-1A	4,423	1,684	160
TO-1D	3,818	1,509	148
U-6A	3,138	1,557	157
U-1A	563	520	51
U-8D	567	733	139
U-9C	95	185	42
OV-1A	117	70	11
CV-2A	59	61	11
OH-13	2,923	1,260	146
UH-19	1,200	556	49
CH-21	715	289	26
OH-23	3,110	987	108
CH-34	1,113	416	39
CH-37	137	101	7
UH-1	614	248	23

This table indicates total number of aviators, by designation, qualified in various aircraft. The figures include Active Army, USAR, and NG. Of the 7,300 cards received nearly 1,000 did not supply this information.

DESIGNATION BY PERCENTAGE

	Aviator	*Senior Aviator*	*Master Aviator*
Active Army	70.2	26.6	3.2
National Guard	74.2	25.4	.4
USAR	61.5	36.7	1.8

This table indicates by percentage the designation of aviators of the Active Army, NG, and USAR.

INSTRUMENT QUALIFICATIONS

	Aviator	*Senior Aviator*	*Master Aviator*
F/W Standard Card	74.0	26.0	
F/W Special Card	17.4	60.5	22.1
R/W Standard Card	75.1	24.9	
R/W Special Card	35.6	55.5	8.9

This table indicates by percentage the type card of instrument rated aviators. On their 1962 exam answer cards, 1,158 aviators indicated they were not instrument rated.

The answer cards indicated that a total of 56 aviators failed the 1962 annual written examination once. Of the 56 failures, 47 were aviators and 9 were senior aviators. There were no master aviator failures.

Out of the possible 50 correct answers on the 1962 exam, the following were the average scores:

Version #1	46.04
Version #2	43.16
Version #3	45.18

As you review for and take the 1963 annual written examination, bear in mind the purpose behind the exam. It is not intended as "another requirement"; rather it is a good test of your professional knowledge. With the modern equipment in the Army aircraft inventory, we must all keep abreast of changes and be ever conscious of our responsibilities. The annual written examination is just one of the many aids we can use to stay proficient.

READ AND HEED

Effective 15 May 1963 the U. S. ARMY AVIATION DIGEST will be distributed according to the pinpoint distribution method.

DA Circular 310-47, dated March 1963, is authority for this change. The circular is on its way to you from TAG. Be on the lookout for it. Read it! Heed it! We will have more information in the May issue. The new circular makes if *mandatory* for all units and activities requesting distribution of the DIGEST to resubmit their requests by 30 April 1963 in order to get the magazine without interruption.

The Aviation Combat Developments Agency

Lieutenant Colonel Morris G. Rawlings

ON 30 JUNE 1962, general order 9 from the United States Army Combat Developments Command established the Aviation Combat Developments Agency at Fort Rucker, Ala., and assigned it to the Combined Arms Group at Fort Leavenworth, Kan.

The U. S. Army Aviation School transferred 18 officers from the School's roster to that of the new command, and on 6 July the Combat Developments Agency became an operating organization.

What does the new agency do? How does it differ from the old Combat Developments Office?

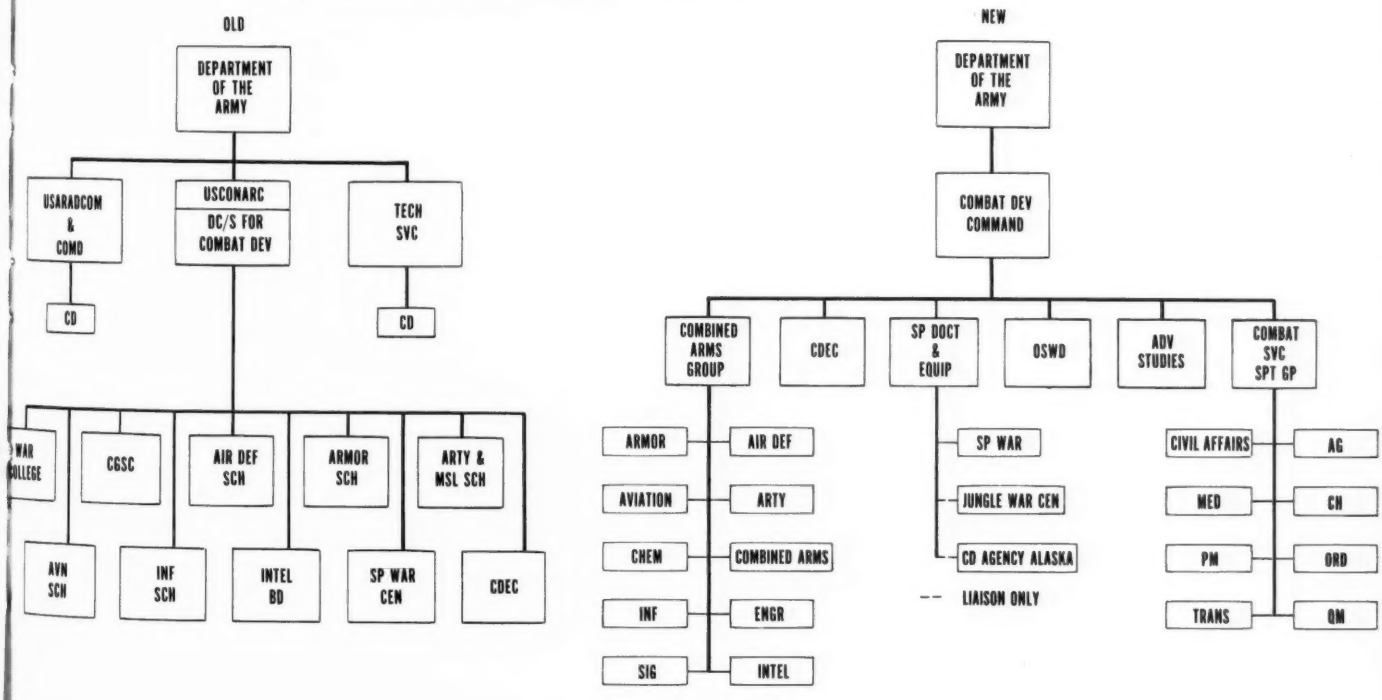
To get a clear picture of the entire changeover, it is necessary first to compare the old Combat Developments System with the new. Below is that comparison in chart form.

The Combat Developments Command has but six major subordinates who report to it directly. One of these subordinates, the Combat Service Support Group at Fort Eustis, Va., is responsible for the activities of those agencies once accountable to the technical services. Another, the Combined Arms Group at Fort Leavenworth, Kan., supervises the efforts of those agencies once accountable to the service schools.

Critics of the old system often

Col Rawlings is Chief of Advanced Studies, Aviation Combat Developments Agency, Fort Rucker, Ala.

Combat Developments Command organizational charts



included a denunciation of parochialism, generally referring to the assumption that each school would present only those facts favorable to a particular viewpoint, leaving to USCONARC the Herculean job of adjusting and coordinating. The new system interposes a coordinating headquarters between agency and command, and removes the various schools and technical services from the Combat Development chain. Parochialism, whether it be good or bad, is not allowed to reach the headquarters of the Combat Developments Command.

The Aviation Combat Developments Agency, containing personnel from the several branches and services, works through the Combined Arms Group to perform its functions and accomplish its mission.

The mission: to develop current doctrine and future concepts, including organization and tactics relating to the operations and administrative support of aviation units (except for those units for which primary responsibility has been assigned elsewhere); and to develop materiel requirements for U. S. Army aircraft and related equipment, incorporating, as appropriate, input data of a tactical or technical nature provided by the combat arms and technical service combat developments agencies.

The functions:

Advise other agencies in developing doctrine, including operational and organizational concepts, capabilities, and limitations, relating to the employment of Army aircraft in operations for which other agencies are responsible.

Assist other agencies in the development of procedures and techniques in support of aerial mapping, aerial surveillance, and aerial target acquisition.

Prepare field manuals, TOEs, and future concepts for aviation areas of primary doctrinal responsibility.

Prepare input data for areas of secondary responsibility and furnish it to the agency having primary responsibility.

Review, evaluate, and coordinate doctrine and concepts developed by other agencies, and/or provide advice and assistance.

Prepare developmental objectives and materiel requirements for Army aircraft and related equipment.

Recommend requirements for new materiel or improvements of existing equipment.

Recommend, plan, and observe troop tests, maneuvers, and special exercises involving employment of Army aircraft or related equipment.

Represent aviation as directed at worldwide activities involving the development of new materiel, doctrine and organization, particularly in NATO or Tripartite Standardization matters.

Prepare a recommended basis of issue of new equipment to aviation units.

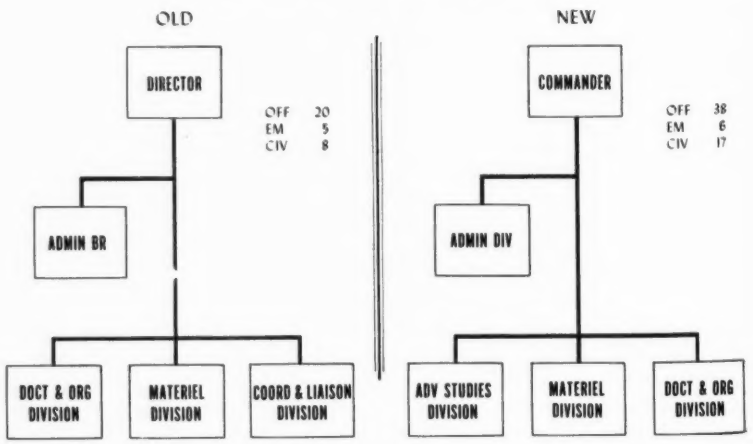
Keep informed of technological developments affecting aviation and make timely recommendations regarding military application.

Coordinate with the commandant of the U. S. Army Aviation School to ensure the proper interrelation of the development of doctrine with the presentation of instruction.

The Agency, with an increase in functions and a more demanding mission than that prescribed for the original Combat Developments Office, required but little reorganization. A comparison between old and new organizations is shown below.

Most of the additional personnel spaces were required in the Doctrine and Organization Division to be used in the preparation of field manuals and TOEs. Other spaces were required in the Materiel Division, where the preparation of QMDO/QMR is a demanding task which requires specific knowledge in technical areas. Some personnel were needed in Advance Studies, where the shape and substance of the future is evolved from knowledge of the present, and where an ambitious study program is proposed. Finally, and truthfully, other personnel were required to enable us to do those jobs which just hadn't been done before. All organizations are plagued with the necessity to

ACDA organization charts



deal with crash actions, the brush fires of the present, and allowances are made for this contingency. However, when an organization formed for the express purpose of preparing for tomorrow finds itself devoting its entire effort to accounting for its actions today, then important work is deferred or forgotten.

Sharp eyes will long ago have picked up that portion of the missions and functions which restricts our major effort to those aviation units for which we have primary responsibility, but it does not enumerate such units, nor does it list those for which we have only a secondary responsibility. It is in this area of proponency that most misunderstandings arise, and it is here that the harsh words of the past act to the detriment of all, particularly all Army Aviators.

This agency has proponency for those aviation units assigned it as a responsibility by higher headquarters, and assumes proponency for those which it conceives. Conceptual units may be, and have been, assigned to other agencies by higher headquarters even after hours of brain sweat have gone into their creation. In each case, the gaining agency has accepted primary responsibility for the promulgation of a concept which puts more Army aircraft into the field, thus improving the Army's mobility. No advocate of Army Aviation should object to such a result.

This agency, with its assigned mission and many functions, is but one link in the chain of combat developments. Our job will be completed only when the three questions posed by Lt Gen John P. Daley, commanding general of the Combat Developments Command, have been fully answered:

"How should the Army be organized?"

"How should the Army be equipped?"

"How should the Army fight?"

Our future may well depend upon those answers.

Army Flight Status Review Boards

THE ANNUAL Department of the Army Flight Status Review Boards will convene beginning in the last week of April 1963 to screen the personnel and flying records of all Army Aviators on active duty. These review boards are an integral part of the U. S. Army's flight status selection system, which is designed to ensure that only qualified officers are retained on flying status.

The review boards work on the basis of "future potential"; an Army Aviator is considered both on the basis of his flying skill and his potential as an Army officer for future leadership or key staff jobs.

The findings and recommendations of the Flight Status Review Board are based on an objective evaluation of the individual aviator's flight record files and other official personnel records available within Department of the Army. Individual aviators do not appear before the Board, although they are encouraged to submit any official information for the Board's consideration which they feel may not already be a part of their records. Army Aviators recommended for suspension from flying status by Flight Status Review Board action will be notified by Department of the Army through appropriate command channels.

MAYDAY! MAYDAY! MAYDAY!

ASK ANY AVIATOR the meaning of MAYDAY and he will immediately say it is an aviator's way of telling you he is in trouble. But few will be able to tell you why this particular word is used.

Recently several aviators were asked this question. None knew the correct answer. One said he thought it came from the holiday May Day, now celebrated more or less as a Communist holiday. Another said, "Since it has Communist overtones it undoubtedly is the result of a compromise with them." A third said that if this were true he did not think that propaganda had any place in something so serious.

But the word "Mayday" is not English at all, and it has nothing to do with the holiday. It is a French word spelled m'aidez and means "Help me!" It was adopted as a distress signal for ships and aircraft by International Radio Regulations because it is brief, clear and unmistakable, and because it can be pronounced in most languages.

A CREWCHIEF S

RECENTLY, a crewchief we've known and admired for several years paid us a visit while en route to his new assignment. He'd just returned from an overseas tour as line chief in a 4th echelon maintenance unit.

A master sergeant with 16 years' service, he's 6 feet, 2 inches, and 200 pounds of ramrod-straight soldier. His Scotch ancestry shows in his ruddy complexion, shaggy brows, and the twinkle in his eye. An aviation enthusiast and dedicated mechanic, he knows Army aircraft inside out. He's the ideal picture of a real professional.

After the usual tales that follow an overseas tour, he began to talk about maintenance. We recorded his part of the conversation. It contains some common sense knowledge we think is worth passing on.

* * *

"The most important guy is still the CO. Our first one was all that you could ask for. Oh, he was a little hard nosed at times, but he knew the score, he was

---

Prepared by the United States Army Board for Aviation Accident Research.

SPEAKS OUT

fair, and you always knew where you stood with him. He ran a maintenance unit, and aircraft maintenance came first!

"After he left, we got one of those grasscutter types, and maintenance took a back seat. Instead of OJT, the new guys were put to painting the buildings and picking up butts.

"It wasn't long after this until one day I came across a Beaver being rolled back to the line by two guys who'd joined the unit a week before. Just for the heck of it, I checked the book. Sure enough, there was no entry about removing the wings.

"I knew I had seen the Beaver with the wings off the day before, so I asked one of the men why there was no entry. He told me they hadn't performed any maintenance on the wings, but had just taken them off to make it easier to get the aircraft in and out of the hangar, so he didn't see any reason for an entry.

"I proceeded to give them a few kind words about what would and would not be put in the book. Then I made them take the wings off and reinstall them so I could watch every move. I don't think they'll forget again, but it wasn't really their fault. The guy who should have been in charge of that maintenance was out standing guard!

"One thing I'd like to see, if it could be worked out, is for the guys right out of school to be sent to organizational maintenance for some seasoning before they're assigned to field maintenance. I know they've got to break in somewhere, but it would help if they could get used to working around aircraft on the line and doing the smaller jobs first.

"I read about those accidents where a cotter key was left out and I wonder what the *real* cause was. We all know that nobody would do something like that on purpose, so there must be some reason for it.

"Was it because somebody with little or no experience did the work without help?

"Was an experienced mechanic interrupted while the work was going on? I can remember being pulled off a job to do something else, then come back and couldn't remember where I'd left off. If you don't start all over again, you're liable to leave something out.

"If maintenance work is written up like it should be, I don't see how that kind of thing can slip by an inspector. But if it's not in the book and he doesn't know what work was done, how does he know what to look for without taking the whole thing apart?

"I think some of this hurry-up maintenance could be the reason. If maintenance is scheduled like it should be, and there's time to do the work properly and have it inspected, there's not much chance of an unsafetied bolt getting by.

"But where some guy's trying to set a record and the rush is on to get the work out under less than a reasonable time, somebody is liable to goof.

"The flight surgeons write a lot about pilot fatigue, but mechanics get tired, too! Stand one on guard duty all night, rush him through an inspection the next morning, and he's tired before he ever gets to work. He won't do his best work when this happens.

"Like everybody else, mechanics need motivating. They need enough working space, enough light, enough equipment, enough tools, and most of all, enough time to do a good job. Give 'em these and you'll have good maintenance!"

Successful accident investigations demand

OPEN MINDS

WHAT MAKES a good accident investigator? Integrity? Perseverance? Experience? Certainly, these are desirable qualities but there is one trait that is absolutely necessary to any successful investigation—an open mind.

A good accident investigator has no preconceived notions. He must proceed with the idea that he doesn't know the answers. The trouble with having preconceived ideas is that a person unconsciously looks for evidence that will fit only those ideas. With a closed mind, he may overlook any number of significant items.

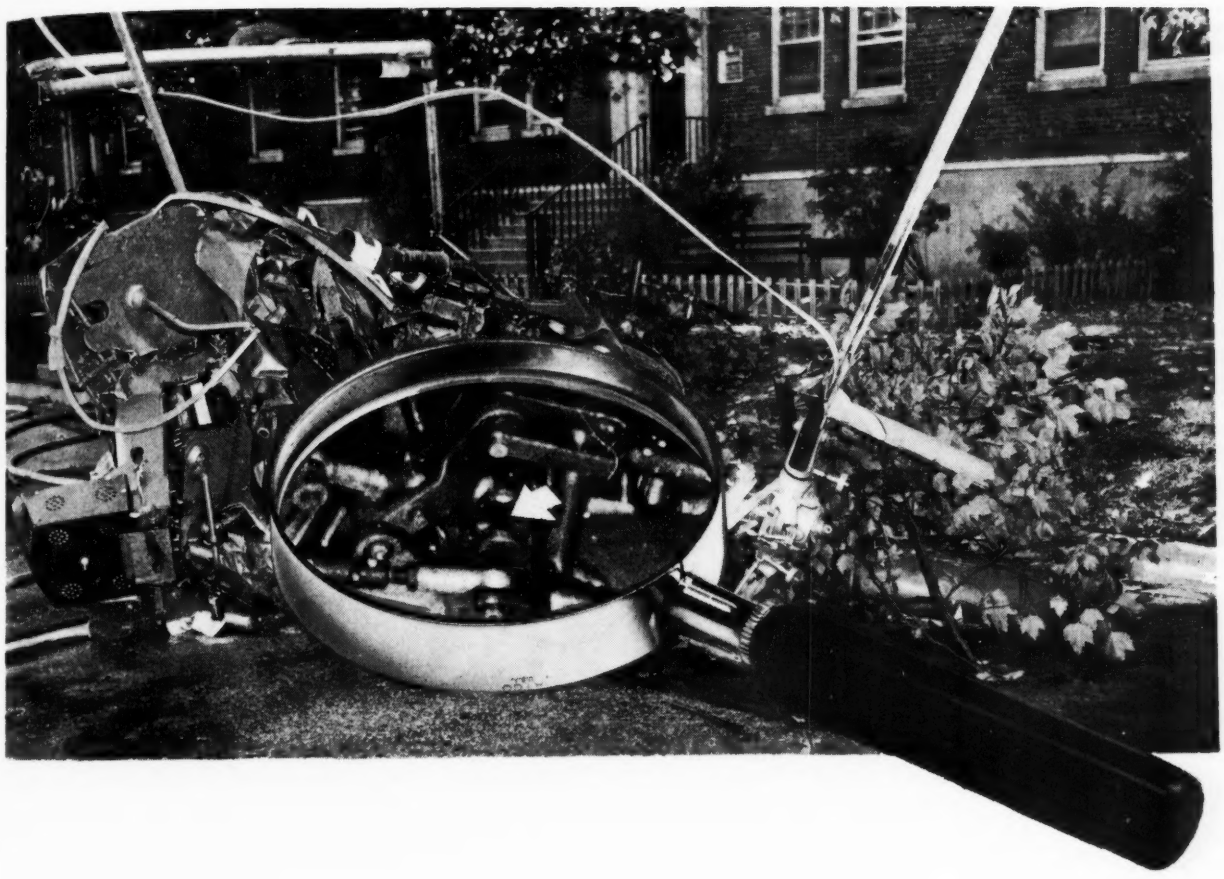
The accident investigator should discipline himself to look for all possible cause factors, and the investigation must be continued to a point where all concerned agree that nothing more can be learned. Conditions are often uncovered which may be potential accident causes, even though they have no direct bearing on the accident being investigated.

...HAVEN'T BEEN OUT THERE YET, BUT YOU CAN TELL SALVAGE TO PICK IT UP. LOOKS LIKE ANOTHER CASE OF PISTON FAILURE FROM HERE!
INVESTIGATOR

Accident reports show the need for some organizations to brush up on their preaccident plans. This bears out the old adage that "what looks good on paper doesn't always work out in actual practice." An accident happens and everyone runs in six different directions at once. The only way to have a preaccident plan that works is to rehearse it—and rehearse it—and rehearse it again, until every last detail has been ironed out in actual practice. The fundamentals for a good preaccident

---

Prepared by the United States Army Board for Aviation Accident Research.



plan can be found in DA Pamphlet 95-5. It's up to the individual units to adapt this plan to their particular circumstances. When did YOUR unit have its last full dress rehearsal?

A particular need exists for more emphasis on preserving the scene of the accident so physical evidence can be studied and recorded before it is moved. Too often the scene is tracked up badly by footprints and vehicles. Not a single item should be touched or moved until it has been carefully studied or photographed. A complete set of photographs may be the only source of accurate information.

A prime example of this was an OH-13 that crashed on an apartment house roof in a large city and fell to the street below. Because of its location the wreckage could not be roped off and left for a thorough investigation. A sharp investigation board directed the taking of many photographs from every possible angle before the wreckage was carted away.

From witnesses' statements it was suspected that the pilot had experienced control malfunction. Examination of the wreckage revealed that a bolt was missing from the cyclic control linkage. Since the wreckage had been moved, this bolt could have been lost in transit.

However, an exhaustive review of the photographs produced a picture which conclusively proved that the bolt was missing at impact. The cost of pictures is small indeed when weighed against the successful solution to a past accident and the prevention of future accidents.

A complete mapping of wreckage is necessary, even to the smallest of pieces. Physical evidence is probably the most important portion of the investigation. Why? Because it gives you black and white answers.

Accident reports indicate that some accident investigation boards are falling down in organizing the investigation. Others reveal that members sometimes delay working on the board because of other duties. AR 385-40 states that the board takes priority. Once an accident investigation has begun, officers should not be changed unless for some pressing reason. Changing investigators results in confu-

sion because the new members don't know what has been done by the members they replaced.

The procedure for shipping material to be analyzed is not fully understood by some. This is covered in paragraph 28, DA Pamphlet 95-5. Major commanders of overseas commands have authority and funds to perform or contract for laboratory analyses of suspect parts.

Legal swearing-in of witnesses should not be done. This practice is likely to alter testimony. The witness will probably say what he thinks you want to hear, rather than what he actually observed. He should be assured that his testimony will not be used in a court of law or to punish anyone. It should be made clear that his information will be used only to help prevent future accidents.

Witnesses with little or no aeronautical background may require special handling. It is a good idea to go to the scene with such a person and take along a model of the aircraft involved. This would help reconstruct the action where otherwise the testimony would be vague and of little value.

It is not uncommon to have several people give contradictory reports of a particular accident. There are several reasons for this. In the first place, people have different emotional makeups. Also, the power of recall is not always reliable, especially when a catastrophe occurs. Events sometimes happen so fast that they don't register on the observer's mind in the proper sequence. If you get conflicting reports from several witnesses, refer to paragraph 14, DA Pamphlet 95-5. One of the most common examples of misinterpretations by witnesses is seen in the many false reports of in-flight explosions which turn out to be the crash of ground impact.

The Army needs more skilled investigators in the field. Graduates of the Army Aviation Safety Course at the University of Southern California should be used whenever possible.

The aviation safety officer should devote his efforts primarily to the prevention of accidents. However, when an accident occurs, it is extremely important that the investigation be conducted in a proper manner. Aviation accident research is completely dependent on thorough investigating and accurate reporting. The quality of this research is only as good as the information you furnish.

New Survival Aid

THIS POCKET-SIZED, 7-ounce plastic bag to be carried by the nation's MERCURY astronauts as part of their survival equipment becomes an aluminized mylar reflector when inflated. It has been tested in the Atlantic Ocean, where it was sighted in the water by aircraft radar from a distance of 48 miles. Similar devices are expected to be applicable for use by stranded yachtsmen, explorers, or survivors of downed aircraft. It is made by Geophysics Corporation of America's VIRON Division, Anoka, Minn.

A better understanding of the torque wrench and its function can be an effective tool in the accident prevention program.

Torque

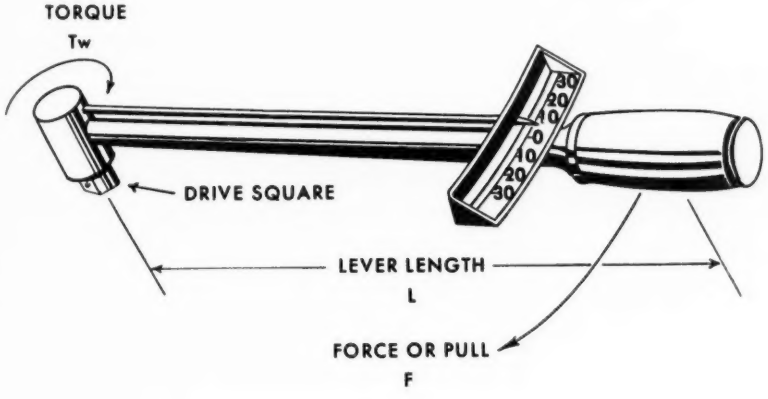
Captain Jerry A. Simmons

VISUALIZE AN energetic young mechanic who has recently joined your unit—fresh from a unit that has the same type aircraft you are flying. Immediately, the maintenance officer gives a sigh of relief; he is no longer worried about the fellow's technical ability. Then early one day the new mechanic was instructed to check the torque of the transmission bolts. Fine — this gives the chap a chance to go to the tool room and check out one of those shiny wrenches with the dials. After an hour of diligent work, he walks to the maintenance officer and says, "Sir, this bolt just broke." Just now everything is in a state of mass confusion because helicopter 1908 is scheduled for a flight at 0930 hours.

This and many other cases of improper use of the all-important torque wrench has caused many aircraft to be grounded for repairs, new parts, or, in some cases, totally destroyed.

Shall we take a look at TORQUE and what it can do for us? Torque is based on the fundamental law of the lever: force times distance equals the moment or torque about a point.

The figure below represents a torque wrench. The arrow pointing downward at the handle of the torque wrench represents the force or pull which is exerted by the operator. The force or pull is designated as F.



The distance between the centerline of the drive square and the centerline of the force being applied at the handle is the lever length of the wrench, designated as L.

The curved arrow about the drive square of the torque wrench represents the torque which is being applied to the nut or screw. This is also the torque which is indicated on the dial of the wrench and will be represented as T_w.

To calculate the torque at the drive square it is necessary to multiply the lever length, L, times the force, F. This is shown in the following formula.

T_w = Torque
F = Force $\quad T_w = F \times L$
L = Lever length

The lever length, L, of the wrench may be measured in inches or feet, whichever is desirable. Force, F, may be measured in pounds or ounces, but it is necessary to specify which

---

Capt Simmons was a student in the Aviation Safety Division, University of Southern California when this article was written.

unit of measure is used in making the calculation. If the lever length is measured in feet and the force in pounds, the torque developed should be referred to as foot-pounds.

Many parts have been improperly installed or torqued to the point of failure because an improper torque specification was used or torque conversion was not considered. It is often advantageous to change a torque specification from inch-pounds to foot-pounds. To do so, we must remember that the conversion is based on the fact that there are 12 inches to a foot; then it is evident that 1 foot-pound equals 12 inch-pounds. The following formulas may be written:

Ft.-Pounds $\times$ 12 = In.-Pounds
In.-Pounds $\div$ 12 = Ft.-Pounds

Somewhere in my study of physics, I ran into Hooke's Law which meant absolutely nothing at the time. But taking another look with my newly acquired knowledge, based on Hooke's Law we can state that within its elastic limit the deformation of steel is proportional to the load to which it is subjected. This means that if a 1-pound load were placed on a spring and the spring deflected 1 inch, then the spring would deflect 2 inches if a 2-pound load were placed upon it, etc. The spring would continue to deflect 1 inch for each additional 1-pound load until the stress reaches the elastic limit of the steel. As long as the elastic limit of the spring is not exceeded, it will return to its original shape when the load is removed.

The measuring element of all torque wrenches in common use today employs one form or another of the principle of Hooke's Law.

The main purpose of torquing is to prevent cyclic loading and resulting metal fatigue. To accomplish this, it is necessary to produce a clamping force greater than the force tending to separate the joints or parts. Improper torquing presents various problems. For instance, undertorquing permits cyclic loading which will result in metal fatigue, and overtorquing will strip threads and cause bolt failure.

The proper use of torque wrenches and torque specifications is of vital concern to every maintenance officer, pilot, and mechanic. It will require a good training program with constant supervision to ensure that torque wrenches are used properly. Another problem area is calibration. Needless to say, using an improperly calibrated torque wrench can be just as dangerous as not using one at all. During my last assignment, we found that torque wrenches turned in as unserviceable were being reissued as serviceable on the basis of a visual inspection. From this I would strongly recommend that each torque wrench be calibrated before use, with routine calibration inspections as required. [While the Army has no specific regulation on the torque wrench, AF TO 32B14-3-1-101 is widely authorized for use in determining calibration requirements.]

No chain is stronger than its weakest link. So perhaps we should take a look at our operations to see whether we are able to answer these questions with a positive "yes."

Do all mechanics know how to properly use the torque wrench?

Do all mechanics know how to find torque specifications for required nuts, screws, or parts?

Do all mechanics know how to convert foot-pounds to inch-pounds or vice-versa?

Do all mechanics know the results of improper torquing?

Are torque wrenches being used as and when required?

Are torque wrenches properly calibrated and marked?

Are required torque wrenches on hand or on requisition?

If these seven basic questions are answered "yes," we have taken a step in the right direction, but let us not forget that the torque wrench is an important instrument that can save time, material and, in many cases, lives.

USE IT WISELY

The wonderful world of nuts and bolts and your new assignment is . . .

Captain Jack W. Serig

GOT A GOOD assignment? Completely happy with your job? Something's bound to happen! In my case I was appointed maintenance officer in my unit. *Me!* The man who didn't know an end wrench from a screwdriver.

In my mellower moods I can now sit back and see that it wasn't such a bad deal after all. I'll admit I've still a lot to learn —I know very little of the innards of an R 1340 even though I am responsible for 16 Otters— but the very fact that I had no maintenance background enabled me to have a fresh approach to many old problems. I would like to share some ideas with fellow maintenance officers, since I can now include myself in the happy fraternity.

One of the first things I noticed when I reported to my new job was the attitude of the personnel toward the higher third echelon maintenance unit which supported us. Maintenance supervisors and mechanics alike had nothing but blasphemous comments on their maintenance support.

Having no previous prejudices to bias my judgment, I reasoned that most units in the Army today are doing as good a job as possible under the circumstances. If proper support was not being furnished there must be cogent reasons. I proceeded to find out why.

Well, there were many reasons. Most of them turned out to be common ones that confront all units, regardless of their missions. But our sister unit had about all of these problems she could handle without any additional agitation from us.

My solution was to simply call the men together and let them know the reasons for the poor support. Then I asked for patience and constructive criticism. Soon many ways to improve the situation were suggested. After establishing a cordial atmosphere with their commander I offered the suggestions for what they were worth and also asked for any he might make which could help solve our mutual problems. Rather than being at each other's throat, we soon developed a fine spirit of understanding and cooperation that eased our mutual problems.

Due mainly to my inexperience in the maintenance field, it was six months before I gained enough knowledge of the men in the unit and their work to

---

Capt Serig was with the 18th Avn Co (FWLT), Nha Trang, South Vietnam when this article was written. He has over 1500 flight hours in helicopters and fixed wing aircraft.

judge their capabilities. When I felt I knew them sufficiently I started reducing the deadwood in my maintenance forest. Fortunately only a few were dragging their feet or simply not carrying their full load. After a trial period those who didn't show sufficient improvement were either transferred to jobs commensurate with their abilities or reduced. Other individuals saw the light when their promotions were held up.

Housekeeping details presented another problem area. The service platoon is the largest in the company, so naturally it was called upon to support details to a larger degree. This had a definite effect on aircraft maintenance and on occasions there were only enough personnel to form one four-man maintenance crew.

My answer to this was to split the 25-man maintenance section into two squads, appointing the senior mechanics as squad leaders. One squad worked at night and the other in the daytime. The squads rotated to the night shift every other week. Since most housekeeping details are done during the day, I have found that the night shift is able to work a full week doing nothing but maintenance work. Each squad appreciated the fact that they could do an entire week of uninterrupted maintenance. Productivity of the night shift has increased two and threefold over that of the day shift.

I have also set up a working arrangement to fit our particular needs. The two diagrams show the authorized TOE and the working arrangement I innovated.

Starting with the platoon headquarters, I combined the parts specialist slot with that of the extra mechanic from the maintenance section, forming a new section which I call the tech supply section. The two men in the section understudy each other, which allows for better continuity.

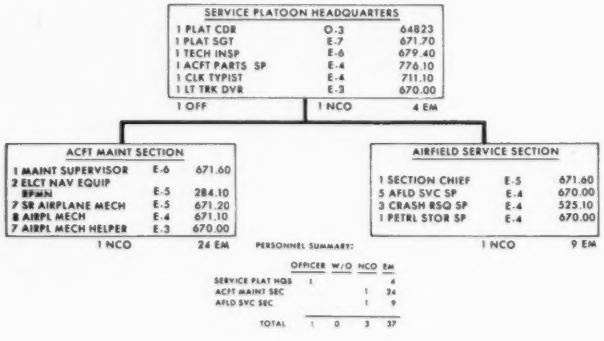
Over this section I have placed a warrant officer who also heads the airfield service section. The other warrant officer shown in the diagram is the assistant maintenance officer. These WO positions are additional duty type positions.

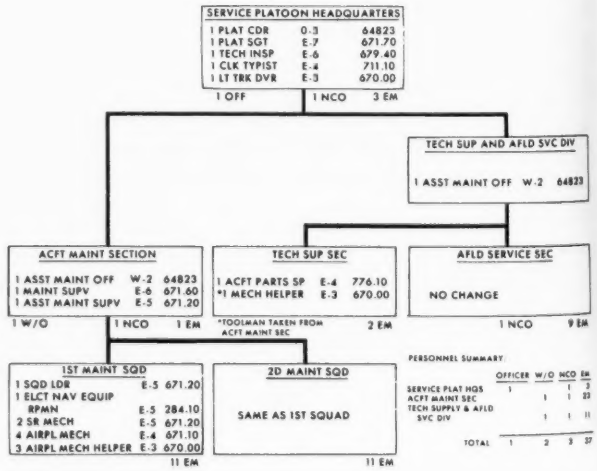
In the maintenance section, the two-squad concept is compatible with the two transport platoon organization. When it is necessary to dispatch a platoon to support a unit for any given length of time, one maintenance squad with its equipment goes with it.

The age old problem of who should control aircraft maintenance, the operations officer or the maintenance officer, beset me. When I first took over as maintenance officer I found that aircraft missions dictated when maintenance was to be performed. As a consequence, maintenance scheduling could not be accomplished. As many as 17 periodics were performed in a one-month period on our 16 aircraft. Some of these aircraft would fly 10 to 20 hours per month while others flew 80 to 90 hours. This has been changed now. Schedules are set up and maintained. This, of course, requires a lot of coordination between the service platoon and the transportation platoons, but it's worth it.

At this writing our unit is en route overseas, and the problems left behind are probably trivial compared to those to be encountered. How efficient this new working arrangement is under overseas conditions remains to be seen, but if past performance can be used as a yardstick I don't anticipate any major difficulties. In fact I'm looking forward to future work in this field. Being a maintenance officer is an interesting, stimulating assignment. Try it!

Right: Actual working organization, 1 officer, 2 WOs, 40 EM. Will it work in your outfit?
Below: TOE 1-107T Aviation Company (FW) (LT). Authorized organization, 1 officer, 40 EM.


SERVICE PLATOON HEADQUARTERS
1 PLAT CDR O-3 64823
1 PLAT SGT E-7 671.70
1 TECH INSP E-6 679.40
1 ACFT PARTS SP E-4 776.10
1 CLK TYPIST E-4 711.10
1 LT TRK DVR E-3 670.00
1 OFF 1 NCO 4 EM
ACFT MAINT SECTION
1 MAINT SUPERVISOR E-6 671.60
2 ELCT NAV EQUIP RPMN E-5 284.10
7 SR AIRPLANE MECH E-5 671.20
8 AIRPL MECH E-4 671.10
7 AIRPL MECH HELPER E-3 670.00
1 NCO 24 EM
AIRFIELD SERVICE SECTION
1 SECTION CHIEF E-5 671.60
5 AFLD SVC SP E-4 670.00
3 CRASH RSQ SP E-4 525.10
1 PETRL STOR SP E-4 670.00
1 NCO 9 EM
PERSONNEL SUMMARY:
OFFICER W/O NCO EM
SERVICE PLAT HQS 1 4
ACFT MAINT SEC 1 34
AFLD SVC SEC 1 9
TOTAL 1 0 3 37


SERVICE PLATOON HEADQUARTERS
1 PLAT CDR O-3 64823
1 PLAT SGT E-7 671.70
1 TECH INSP E-6 679.40
1 CLK TYPIST E-4 711.10
1 LT TRK DVR E-3 670.00
1 OFF 1 NCO 3 EM
TECH SUP AND AFLD SVC DIV
1 ASST MAINT OFF W-2 64823
ACFT MAINT SECTION
1 ASST MAINT OFF W-2 64823
1 MAINT SUPV E-6 671.60
1 ASST MAINT SUPV E-5 671.20
1 W/O 1 NCO 1 EM
TECH SUP SEC
1 ACFT PARTS SP E-4 776.10
*1 MECH HELPER E-3 670.00
*TOOLMAN TAKEN FROM ACFT MAINT SEC
2 EM
AFLD SERVICE SEC
NO CHANGE
1 NCO 9 EM
1ST MAINT SQD
1 SQD LDR E-5 671.20
1 ELCT NAV EQUIP RPMN E-5 284.10
2 SR MECH E-5 671.20
4 AIRPL MECH E-4 671.10
3 AIRPL MECH HELPER E-3 670.00
11 EM
2D MAINT SQD
SAME AS 1ST SQUAD
11 EM
PERSONNEL SUMMARY:
OFFICER W/O NCO EM
SERVICE PLAT HQS 1 1 3
ACFT MAINT SEC 1 1 33
TECH SUPPLY & AFLD SVC DIV 1 1 11
TOTAL 1 2 3 37

The Aerial Escort Platoon (Proposed)

Captain Henry W. Meetze

THE 66th TRANSPORTATION Helicopter Company (Medium) is en route to landing zone Alpha, flying in vee formation over rugged terrain. Eight armed, utility-type helicopters from the aerial escort platoon form a screen for the group to the front and flanks. Suddenly, the airwaves are interrupted by—TIGER RED, THIS IS TIGER LEADER. SPORADIC GROUND FIRE COMING FROM VICINITY CP 2. INVESTIGATE AND REPORT.

Two choppers peel away from the formation and move to CP 2, a road junction to the right flank. TIGER LEADER, THIS IS TIGER RED. SQUAD OF INFANTRY IN TREE LINE. AM TAKING THEM UNDER FIRE . . . Several seconds pass. . . TIGER LEADER, THIS IS TIGER RED. INFANTRY DISPERSED. RETURNING TO FORMATION. OUT.

This entire action took place over a very short period. During this time, however, suppressive fire was placed on a small ground unit that was capable of harassing, perhaps seriously, the flight of transport helicopters on a combat mission.

Impossible? No. Improbable? Again, no. Airborne units do not make drops deep in enemy territory without aerial escort provided by the Air Force. Bringing the entire operation down to nap-of-the-earth level does not change the situation. Why send Army transport helicopters unescorted into enemy territory?

Several solutions to this problem are available:

Capt Meetze is aide-de-camp to the Commanding General, Sixth U. S. Army, Presidio of San Francisco, Calif.

Use no air escort; however, arm the transports to provide their own suppressive fire.

Utilize an Air Force air cover.

Utilize the Air Cavalry Troop for aerial escort.

Organize an air escort platoon specifically for the mission.

Let us take these solutions one by one and examine their merits. First, use no air escort. This has been tried in Southeast Asia. It has proved to be a solution, poor at best, using a minimum of air vehicles and attached units. Unless the pilots or crew members see the ground bursts, they do not know if anyone is firing at them until the report of the shots is heard. Then it is too late to spot the hostile weapons.

During landing, unloading, and initially during takeoff, the entire formation is extremely vulnerable to small arms fire. The fact also remains that in Southeast Asia, although the guerrilla forces are relatively primitive in their weapons and fighting, they have the potential of becoming more and more sophisticated. Antihelicopter fire could become well organized and include better, more modern weapons. In addition, any hostile armed helicopter intervention would present a very dangerous threat to an unescorted formation.

The second mentioned solution to the escort problem is an umbrella of Air Force fighter aircraft. Immediately, many disadvantages come to mind: problems of intra-service coordination; availability of Air Force aircraft; opposite extremes of operating speeds; inability of fast-moving aircraft to spot, and take under fire, small aggressor units; and, finally, large fuel requirements for short flight time. Few advantages are apparent, but there are so many disadvantages as to make this solution unfeasible.

Doctrine for air escort missions is found in FM 17-36, Chapter 6, on the air cavalry troop. Our third solution must take into consideration the availability of these troops. Obviously, divisional troops must be kept within their parent units. This leaves the nondivisional troops found in the armored cavalry regiments under corps or army control. Again, unless these regiments are completely inactive, the air-cavalry troop will be more gainfully employed.

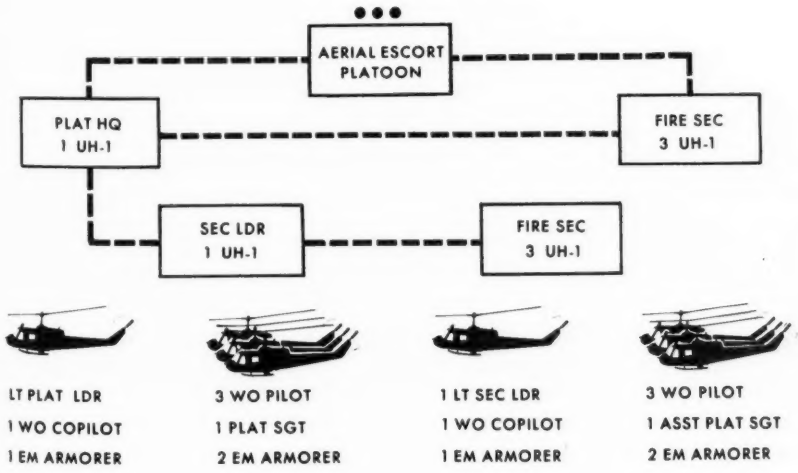
Let's not overdo a good thing. Air-cavalry troops will be subjected to overutilization within the regiment in an active situation, and will need time for resupply, maintenance, and rest. Working solely as an escort unit, the air-cavalry troop will not be used to the maximum of its many organic capabilities.

This leads to the fourth solution: organize a unit WHOSE SOLE MISSION IS AIR ESCORT. In examining a proposed

organization, let us qualify the conditions under which it would be used. The Aerial Escort Platoon (proposed) would be organic to a transportation aircraft battalion. This would generally limit operation to nondivisional units. Each ROAD division has enough organic escort aircraft potential that only under extreme circumstances would the Aerial Escort Platoon (proposed) be used within a division. Using the UH-1 helicopter with its available cruising speed means that this vehicle could act as escort for several operational transports.

The proposed organization of the platoon is shown in the figure below. Four of these platoons would be within the type Field Army. Two sections of four helicopters each were chosen because this organization would be able to provide all-round security to any nominal size formation. Fewer aerial vehicles would give insufficient cover; more would comprise a unit too unwieldly for the proposed mission under one commander.

We have already examined organization and aircraft. Now let us look at armament. The XM-6 7.62mm machinegun kit would be a successful armament system mounted on the UH-1 and would be the main system within the platoon. In addition to automatic weapons, one helicopter in each section should be equipped with the 2.75″ air-to-ground rocket with both HE and smoke warheads. The use of HE is obvious; smoke would be used to screen formations from ground fire, mask landing zones, and mark certain areas to be avoided. Each helicopter should also be equipped with several multicolored smoke grenades.



The ability to perform various missions, all closely associated with escort, is inherent within the platoon due to its type aircraft, armament, and organization. These missions include:

Fly aerial escort for single or multi-aircraft formations.

Place suppressive fire (point or area) on suspected or actual hostile ground units.

Provide a low aerial umbrella (hover cover) over landing zones during loading and unloading.

Perform route reconnaissance in front of transport formations.

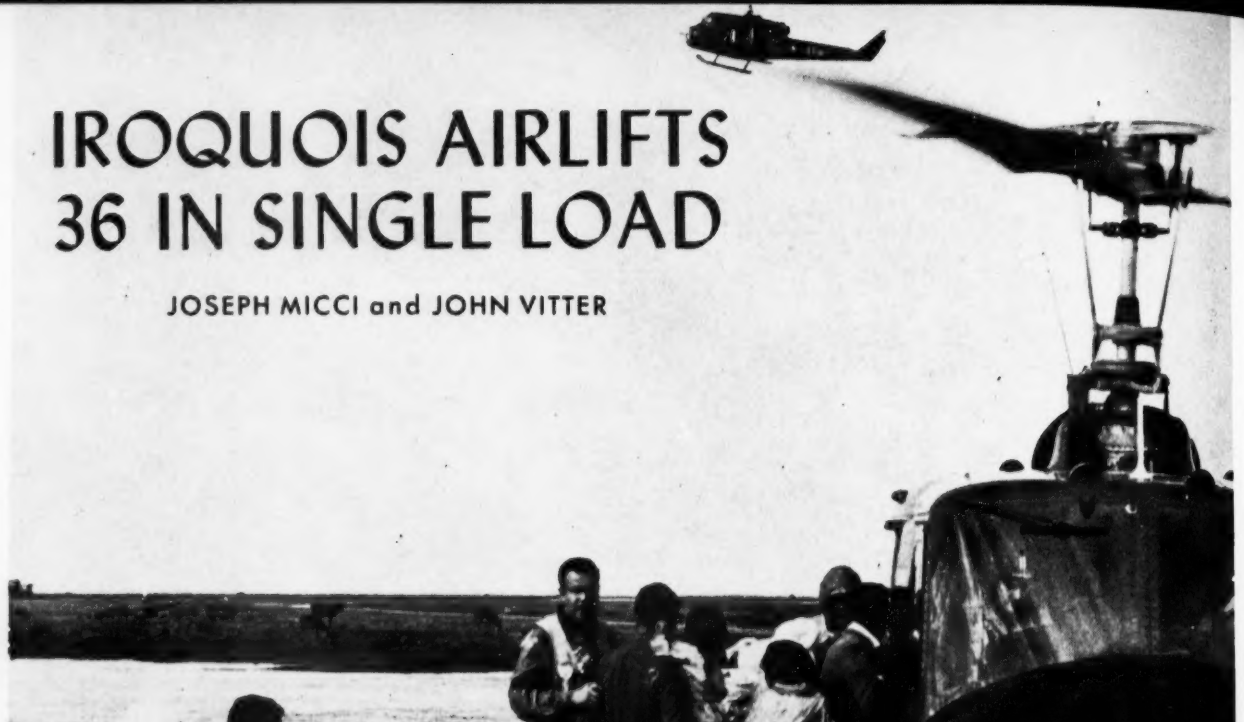
Perform area reconnaissance, e.g., in proposed landing zones.

The need for such a unit to provide aerial escort is obvious. This is a function of aerial warfare in the middle of our battle environment, one that we must quickly realize and do something about. Army Aviation has in the aerial escort platoon just such a solution.

Views expressed in this article do not imply Department of Defense indorsement of factual accuracy or opinion.

IROQUOIS AIRLIFTS 36 IN SINGLE LOAD

JOSEPH MICCI and JOHN VITTER



Moroccan flood victims board an Army UH-1B. Some are afraid and must be urged to come aboard by interpreter.

While talking to the base operations people at Sidi Slimane in flooded Morocco, a report came in that Army Iroquois No. 61-699 had just picked up 32 people, plus an interpreter, crewchief, pilot and copilot. To do this, the crewchief and the interpreter had to stand on the skids during the flight to hold in the people.

THAT THURSDAY morning as we walked into our offices we had no idea that within 24 hours we would be on our way to witness one of the most astonishing sights we had ever seen. Waiting for us were orders to go to Morocco, where the U. S Army, Navy, and Air Force were engaged in rescue operations in one of the worst floods in Morocco's history.

The process of packing bags, securing necessary papers and getting immunization shots took some time, and it was not until 0500 the next day that we were able to report to Rhine Main Airbase for a flight to Chateroux, France. We left Chateroux on a C-124 that was carrying tents and food supplies to the flood area.

The next morning at Sidi Slimane, Morocco, we got the full impact of the steady downpour

that had been dropping on Morocco for several days. The resulting flood had caused some 40,000 people to lose everything they owned—homes, livestock, farms.

A U. S. Air Force communications relay station near Sidi Yahia, 22 miles away from Sidi Slimane, had been set up as a center for refugees. There and at Sidi Kacom as well as Sidi Slimane were more than 15,000 flood victims, many of them rescued by helicopters.

The purpose of our visit was not to view the flood damages. The home office of our respective companies had heard that the two Army Iroquois were lifting more weight than their rated capacity and they wanted it confirmed.

At base operations of the Sidi Slimane Air Force Base we learned that the Iroquois were doing just that. They were picking up 20 to 25 people every trip. This is very significant when you consider that they were designed to carry a maximum of eight people. At first we did not believe it, but an official count was being kept by the Air Force.

In many cases the Army Iroquois had to hover directly over the rooftops to pick up survivors. One pilot reported that he took more than 100 men, women, and children from a huge barn in the flooded area. They were in the loft of the barn, and he had to hover and balance on the edge of the roof as they climbed in, load after load.

At the end of five days of operation, the UH-1Bs had evacuated over 1,400 people, plus making food drops and three or four VIP flights. The Army Aviators said that the engines and aircraft performed perfectly and required only minor repairs.

To facilitate quick entrance and exit the doors were removed from the helicopters and only a rope was tied across the door area

After reaching safety, refugees found personnel waiting to give them medical care, food, and shelter

prepared by
THE U. S. ARMY
BOARD FOR
AVIATION
ACCIDENT RESEARCH

TWX EXCERPTS

From Feb. and March

OV-1

UH-1

U-1A

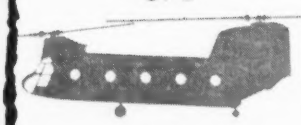
CH-21

O-1

U-6

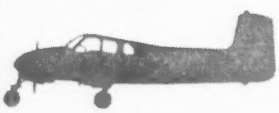
CH-34

CV-2



CH-47A

OH-13

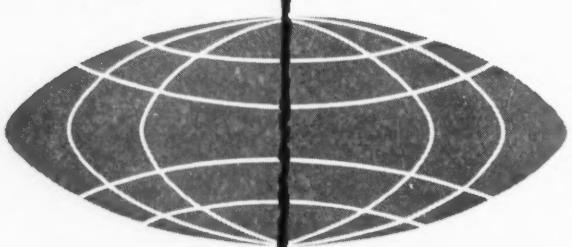


U-8

CH-37

UH-19

OH-23



O-1E ENGINE FAILED in flight and restart was made. Forced landing accomplished with no damage. Engine stopped twice after landing. Caused by fouled spark plugs in Nos. 4 and 6 cylinders. Water also found in fuel tanks.

UH-1B STRUCK TREE during steep approach for landing. Major damage to main rotor blades. No injuries.

OH-13H TAIL ROTOR FAILED during low-level flight. Aircraft touched down in snow-covered ravine. Caused by failure of tail rotor drive shaft. Two holes had been drilled 90° to the holes which held shear pin in tail rotor drive shaft. Historical records showed MWO 55-1520-204-20/2 had been complied with 23 June 1961.

OH-23D TAIL SECTION STRUCK embankment short of landing area during practice autorotation. Aircraft crashed on right side. Major damage to main rotor blades, tail rotor blades, and tail boom. No injuries.

U-8F ENGINE BACKFIRED several times in flight. Forced landing accomplished with no damage. Caused by split insulator on center electrode of spark plug.

UH-19C PITCHED ON LEFT SIDE after pilot heard loud snap while flying at 70 knots and 150 feet above terrain. Aircraft turned 30° and crashed. Tail rotor struck ground, gear sheared, aircraft rotated 180°, and rolled on right side. Aircraft was destroyed. Pilot sustained minor head injury and crewchief sustained minor leg injury. Open quick-disconnect turnbuckle (FSN 5340-632-7C48) was found in the antitorque system. Turnbuckle was not safetied.

OH-23D TAIL ROTOR STRUCK GROUND during practice 180° autorotation touchdown. Aircraft ballooned approximately 12 feet and power was applied. Antitorque failure occurred and aircraft was landed in a turning motion and remained upright. Major damage to tail rotor drive shaft, tail boom, tail rotor blades, left skid and cross tubes, and engine support assembly. No injuries.

OH-23D TOUCHED DOWN TAIL-LOW during practice 180° autorotation. Incident damage to tail rotor blades, tail skid, aft tail rotor drive shaft, and tail boom. Suspect late pitch application.

CH-34A RPM DROPPED from 2500 to 1300 while aircraft was flying with 40" manifold pressure at 40 knots IAS. Ground witness stated aircraft on fire before touching ground. Aircraft destroyed by fire. No injuries. Suspect failure of intake valves. Low ceiling and visibility listed as possible factors.

CH-34A CARGO DOOR BLEW OFF in flight. Door struck right side of fuselage and severed FM antenna.

CH-21C OIL PRESSURE DROPPED during reconnaissance of proposed landing area. Chip detector light came on and engine failed. Aircraft touched down in lava bed and right gear collapsed. Aircraft rolled to the right and was destroyed by fire. Pilot sustained broken leg and lacerations.

CH-34A CARGO COMPARTMENT filled with smoke during flight. Forced landing accomplished with no damage. Cargo consisted of metal frames and batteries. Smoke resulted when one of frames arced across battery terminals.

CH-37B ENGINE MISFIRED and backfired during takeoff. Forced landing accomplished with no damage. Caused by crack in No. 13 cylinder and five fouled spark plugs.

U-8D BRAKE LOCKED during landing. Incident damage to tire, wheel assembly, and brake assembly. Caused by failure of machine key.

CH-47A LOST SECTION of lower No. 1 engine cowling in flight. Suspect cowling latches vibrated loose.

OV-1 NO. 2 ENGINE LOST POWER in flight. Forced landing with no damage accomplished. Caused by malfunctioning EGT thermocouple.

UH-1B CANVAS HELIPAD MARKER was sucked through main rotor blades during hover. Major damage to one main rotor blade and tail boom. No injuries.

CH-21C ENGINE SURGED while flying straight and level at 300 feet. Turn was made toward clear area and engine failed. Aircraft autorotated straight ahead into trees short of clear area. Chip detector warning light nor instruments indicated impending engine faiiure. Nose gear sheared at fuselage. Aft transmission and horizontal stabilizer separated from fuselage, and forward and aft blades damaged. No injuries.

U-6A LIGHTS AND RADIOS FAILED 9 minutes after takeoff in cruise flight. Smoke came through throttle quadrant. Switches were turned off and forced landing accomplished with no damage. Caused by failure of starter, causing overheat and scorching.

OH-13H RIGHT SKID DUG into loose sand during demonstration low-level autorotation. Aircraft skidded forward nose low. Main rotor blade flexed into and severed tail boom forward of tail rotor skid. Console broke loose and passed through bubble. Pilot sustained minor injuries.

OH-13H LANDED at field CP location on snow. Right skid sank into snow and aircraft rolled on right side. Main rotor blades struck ground and aircraft caught fire. Pilot sustained burns on hands and face as he escaped through left door. Passenger sustained fatal injuries.

OH-13H STRUCK WIRES during low-level flight. Major damage to rotor blades, fuel tanks, cyclic control rods, damper links, whip antenna, bubble, and swash plate. No injuries.

Good lubrication practices are invaluable aids in our accident prevention program

Lament On Lubrication

Captain Ralph J. Ritchie

DID YOU EVER use one of those popular little garden tractors? They're real neat —take most of the hard work out of gardening. But they have one bad fault: most of them have planetary gears which must be greased after two hours' operation.

A friend of mine has one of these little tractors. The other day he ran out of grease and borrowed some. His neighbor didn't have regular cup grease, so instead gave him some bearing grease. When he started the tractor he found, to his surprise, that he could not get the planetary gears to move into high. The fiber-like grease held them back.

This is a simple example of improper lubrication. Fortunately for my friend, all he had to do was change the grease and the little tractor worked fine again. When a vital part of an aircraft is improperly lubricated, the consequences can be fatal.

The aviation company maintenance officer is the man responsible for seeing that the aircraft are properly lubricated. To him lubrication means all oils, greases, hydraulic fluids, and lubricants used generally to reduce friction, aid in cooling and sealing, and reduce wear on moving parts.

Capt Ritchie served as Organization Maintenance Officer in the 25th Infantry Division Aviation Company and is presently a staff officer in the 33d Transportation Battalion.

The appropriate -20 organizational maintenance instructions for the aircraft specifies which type of lubricant is to be used, where and at what intervals in the lubrication order or diagram. As new lubricants and better lubricants are added to the supply system these charts are amended.

The unit maintenance officer must be alert to any possible changes and keep his mechanics and crewchiefs informed. Marking and color coding of grease fittings is one method of preventing the mixing of greases.

The possibility of getting the wrong grease in the grease gun is one hazard to maintenance officers and machines. Another is the possibility of putting the wrong lubricant into the grease fitting. In either case the lubricating quality of the lubricant is impaired or destroyed, and the bearings are soon worn beyond repair.

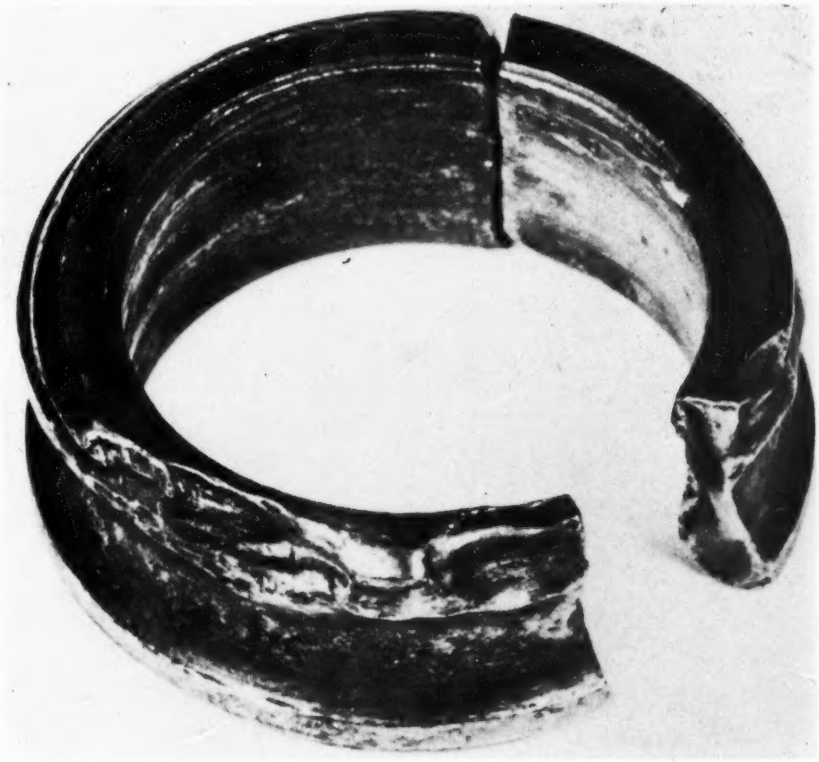
A specific case in point is the swash plate bearings in the OH-13 helicopter which formerly called for MIL-G-25537 grease and then switched to MIL-G-25760 grease. The two greases are incompatible; and the procedure of purging the bearing with the new grease MIL-G-25760 until all of the MIL-G-25537 grease was purged didn't work. Enough of the old remained to cause a serious caking and failure to lubricate; consequently, many bearings were prematurely worn out. [Either grease may be used; however, a change can be made only with a completely clean assembly. See change 1 to TM 55-1520-204-20 for proper procedures for changing from one grease to another.]

From the human engineering aspect the possibility of mixing greases is reduced if only one type of grease is required throughout the aircraft. This isn't possible from the engineering point of view but progress in this direction is apparent. The OV-1, UH-1A and OH-13 can now be lubricated with one grease gun throughout. They require other lubricants but none applied by grease gun. This reduces the possibility of mixing greases to a minimum.

A majority of the significant maintenance considerations to helicopter lubrication have been published in *Aerospace Accident and Maintenance Review* in the August 1962 issue ("Line Level Helicopter Maintenance II", p. 10). Highlights from this article are included here in connection with the broad subject of lubrication and servicing of helicopters.

"The use of . . . lubricants is a necessity in all aircraft, as well as other mechanical devices, but with the helicopter additional factors must be considered—the high centrifugal and rotational forces involved and the tasks this type of aircraft is called upon to perform. Helicopters must operate in every conceivable environment during the course of carrying out assigned missions. Rotor downwash, especially in arid areas, causes sand and dust to be circulated through the rotor system. This tends to contaminate the lubricant used on the many special bearings peculiar to helicopter rotor, drive, and control systems. Special care must be taken to insure that these areas are always properly lubricated and purged of any accumulated foreign material.

The result of an overheated condition caused by faulty lubrication



Some good lubrication practices are:

"1. Use lubricant specified for affected application and temperature. Not only can incorrect lubricants reduce lubricating efficiency, but they may also be incompatible with the lubricant previously used. This may result in caking or have a detrimental effect on adjacent finishes when slung out.

"2. Insure that grease containers and equipment are well identified as to content and kept clinically clean. Leaving grease containers uncovered or dipping into them with dirty equipment can nullify any amount of proper lubrication and generally cause more harm than inadequate lubrication.

"3. Wipe grease fittings clean before lubricating to avoid forcing foreign matter into joints, and after lubricating to reduce the tendency for foreign matter to cling to fittings. This also reduces the possibility of excess grease being slung onto adjacent surfaces.

"4. When it is suspected that a different grease has been used in bearings or equipment, the suspect item should be thoroughly purged or washed in solvent before reservicing with a new type. Always consult the applicable maintenance handbook for specified lubricant.

"Consideration should also be given to the recent application of nonmetallic bearing liners, particularly in helicopter control system mono-ball ends. These liners are principally fabricated from nylon or teflon materials which have an inherent lubricating characteristic. For the most part these bearings require no supplementary lubrication; however, in certain applications the use of special lubricants such as Nylube is specified. Be certain that you apply only the prescribed lubricant.

"Many of the above grease . . . recommendations apply to the use of oils in helicopter systems. These systems should be serviced with specified types of oil for the operating ambient temperature and should be handled with clean equipment. Oil systems of costly components can be contaminated by such offhand carelessness as failure to wipe off a dirty dip stick before inserting it in a tank, or installing dirty plugs in sumps.

"Until recently most helicopter transmission systems were serviced with a heavy-duty oil containing an extreme-pressure additive specially compounded to withstand the high-reduction rotor-driving gear loads. The clinging characteristics of this oil provided fairly good internal corrosion protection, even during extended periods when the system was not being used.

"With the advent of turbine engines, newer lightweight synthetic base oils were developed to provide the required lubrication of the close tolerance turbine engine components under extremely high loads and temperatures. One such oil is MIL-L-7808. In order to reduce supply system problems, this same oil is usually specified for use in transmissions installed in turbine power helicopters. Not only does this oil attack most finishes and common seal materials, but its light weight and lack of adhesive characteristics make for poor internal corrosion protection. Therefore when such oil is used, frequent runup to normal operating temperatures is recommended to protect against internal corrosion. When it is anticipated that the drive system will not be used for periods longer than two weeks, applicable preservation action is strongly recommended.

HYDRAULICS

"Again the principal theme is the use of specified fluid and cleanliness. Until the advent of automatic stabilization and control boost equipment in helicopters, their hydraulic systems consisted primarily of wheel and rotor brakes. There was (and is) an occasional hydraulically actuated hoist or landing gear,

but like the brake systems, these are relatively simple and forgiving. This is not the case with the hydraulic portions of automatic stabilization components requiring that only the cleanest fluids be used and laboratory-type care be taken of open components, lines and filters. [Only the CH-47 ASE equipment has hydraulic components.]

"Second to unclean fluid in causing malfunctions are particles left in the system during assembly or maintenance operations. Cloth lint particles or excess sealant are prime offenders. Inasmuch as the oil filter fineness in these systems is as low as 10 microns (one micron = 0.000039 inch) or lower in special cases, system starvation can easily result if the system is exposed to even small quantities of foreign matter. Relatively trouble-free operations of these systems can only be attained through close adherence to applicable maintenance procedures, use of specified special equipment, and careful handling.

PNEUMATICS

"The primary pneumatic maintenance consideration is personnel safety. In the past few years, for reasons of increased size and ground stability, helicopter tire pressures have reached the dangerous levels of larger fixed wing aircraft tires. The safety margin built into aircraft wheels only applies when all parts are intact and properly secured. If the wheel is ruptured or otherwise damaged from a high-impact landing, for instance, or if the hub bolts are loose or some have been removed, all bets are off! Similar precautions apply to shock struts or any pneumatically, hydraulically, or spring-loaded component. The number

of maintenance personnel permanently maimed or fatally injured while working on such items is dire proof of the consequences of careless treatment of pressure-loaded components.

"In short, before doing any work on a normally pressurized component, be sure that it is deflated or properly discharged! Also, when a high-pressure air bottle is used for inflation, be certain that it is provided with gages and a regulator to indicate bottle pressure and control servicing pressure. An air bottle without this equipment is like an armed bomb with a hair-trigger firing device.

"Another pneumatically and hydraulically serviced unit that takes on special significance when associated with helicopters is the landing gear shock strut. The requirement to absorb adequate landing and taxiing loads is further compounded by ground stability and side-hill landing considerations. Improper servicing can nullify one or more of these important strut operational requirements and under certain conditions result in major structural damage. It is obviously impractical to attempt to maintain strut inflation requirements throughout the normal range of temperature environment and gross weight variations encountered in the normal operating day. Higher temperatures in the morning and evening, and gross weight variations are even less predictable. It is recommended that, when graduated servicing instructions are not provided, the struts be serviced to the norm or average temperature and load conditions for the particular season and operational mission.

"The importance of the man with the grease gun and the care with which he does his work cannot be overemphasized. Erroneously considered by some to be menial in nature, his task is highly specialized. Remember, good lubrication practices aid in assuring reliability and safe utilization of the helicopter by increasing the service life of components."

Every Army Aviator's knowledge of his traveling machine should include more than a simple "kick the tire and light the fire" concept. He should know something about

ENGINE OIL

Lieutenant Harry D. Hunter

WITH THE BIG job that oil has to do in our engines there must be many "Whys" and "Whats" about how it accomplishes this mission along with the many problems associated with such a massive operation it has to perform.

When one dry metallic surface is moved over another, a high resistance or friction is encountered, which results in the generation of heat and excessive wear of engine parts. If a layer of greasy substance or lubricant is placed between the two metallic surfaces, the wear on the metal is practically eliminated and heat is reduced to a minimum. The lubrication system in aircraft engines is designed to meet the problems of high temperatures, high bearing stresses, and proper functioning in all flight attitudes of the aircraft.

An oil must meet certain specifications that will enhance aircraft engine operation. What then are the desirable characteristics of an aircraft oil? We want an oil with the following desirable properties:

- *Adequately high viscosity.* Viscosity is technically defined as the fluid friction or the body of an oil. In simple terms, viscosity may be regarded as the resistance an oil offers to flowing. A heavy-bodied oil is high in viscosity, i.e., pours or

Lt Hunter is assigned to the Power Plants Branch, Dept of Maintenance, USAAVNS, Fort Rucker, Ala.

flows slowly, and may be described as a viscous oil. The lower the viscosity the more freely an oil pours or flows at temperatures above the pour point (which is another characteristic that will be discussed later). Oil that flows readily is described as having a low viscosity.

• *High flash point.* Since oil is used to lubricate the cylinder walls and pistons of internal combustion engines, another major factor stands out among the requirements of a good oil. Because of the large amount of heat generated in cylinders during the power stroke, the flash test of an oil assumes considerable importance.

The flash point test is performed by heating an oil sample and, as the temperature rises, by periodically passing a flame slowly over the surface of the oil. The temperature at which the oil vapor above the sample first ignites is recorded as the flash point. An oil of high flash point is preferred because of the greater degree of protection afforded cylinders, pistons, and the like, and the probable lower oil consumption during continuous engine operation.

• *Chemical stability.* A good oil must show a high degree of chemical stability to resist the action of high temperature, moisture, and acids, all of which often are present in engine crankcases.

• *Low pour point.* Here we come to the problem of cold weather starting, where oil plays a major role. It is not uncommon for internal combustion engines to be started cold at temperatures of 0° F or below. The pour point of an oil is the lowest temperature at which it will pour or flow when it is chilled without disturbance. To determine the pour point, the oil is placed in a glass test jar and cooled in a cooling bath until it ceases to flow. The pour point is determined when the test jar can be held in a horizontal position for five seconds after removal from the bath.

• *High viscosity index.* This desirable characteristic of a good oil is an indication of the viscosity temperature of oils. This index measures the rate of change of viscosity with temperature. The ratings are plotted on an index chart and the oil with a higher number has a higher viscosity.

Oils properly refined from crude petroleum will meet all of the above requirements. To assure that an oil of correct "grade" (viscosity) and quality is used, it is highly desirable to follow the recommendation of the engine manufacturer.

Next, let us look at the problems of oil usage in internal combustion engines. We will look at some of the questions of why some engines use more oil than others and how oil is consumed in an engine. There are three ways in which oil can be consumed in an engine. First, it can be lost by being burned in the combustion chamber; second, through loss of oil mist or vapor from the breather; and third, by leakage where the crankshaft and other shafts protrude from the crankcase.

Other factors also affect oil consumption. Of these, *engine speed* is probably the most important factor. The oil pressure increases with speed until maximum pressure is reached, beyond which the pressure relief valve maintains constant pressure. The effect of centrifugal force on the oil in the ducts in the crankcheeks increases the oil pressure at the crankpins. This increases the rate of oil flow through these bearings. An increase in engine speed also increases the oil temperature and reduces the viscosity.

At high speeds, the rings do not follow the cylinder wall as closely as at low speeds, but tend to act something like a surfboard and ride upon the oil film. Under this condition, more oil is passed to the combustion chamber instead of being scraped back to the crankcase, resulting in a loss of oil.

High engine temperature and *low oil viscosity* tend to increase the loss of oil from the shaft ends and breather pipe.

Condition of engine as to wear is another major factor for the loss of oil. For instance, wear of the various bearings increases the clearance and provides larger areas through which oil can flow out for a given oil pressure. It consequently increases the amount of oil loss by leakage and sprayed on the cylinder walls.

We can also say that when an oil loses its viscosity, or, in other words, *decreases in viscosity,* the oil consumption increases.

Now that we know why we have to continuously add oil to our aircraft engines, let's discover *why* we have to change oil at different intervals. Oil is constantly exposed in service to many harmful substances, which in time will seriously reduce its ability to protect moving parts. The chief agents of contamination are heavy ends of gasoline, acids, moisture, dirt, carbon, and metallic particles. Because of these injurious substances, it is a common practice to drain the oil from engines at regular intervals and to refill with new oil. This brings us to the question of how we determine exactly when oil should be changed. If changed too frequently, needless waste and expense will result; on the other hand, if an oil is used too long, excessive function or wear

will result in mechanical trouble. We can never be sure if we are draining out good usable oil, but a periodic draining as generally practiced seems to be a fairly safe procedure.

Extended and worthwhile experiments are being made with oil samples from our engines to determine if there are possibly any internal engine parts wearing excessively. This has been shown to be a determining factor in checking an engine breakdown before it occurs. [See DIGEST, August 1962, p. 32.]

When away from home base we should make sure that when replacing lost or consumed oil that the correct grade is used. We will not always be in a position where someone else knows and does the maintenance for us. At many stops or locations the maintenance personnel will not be familiar with military aircraft and the type of oil that should be used. And the civilian oil designation is different from that used in the military. So, what should you ask for? No need to sweat, just cut out the table below and stash it where it will always be with you when needed.

The relationship of military grade numbers and commercial SAE numbers (Society of Automotive Engineers) is just a difference in number value. The Society of Automotive Engineers formulated the rating for grade or weight of oil that is used in the United States. We are all familiar with 10 weight, 20 weight, and 30 weight oils. To change SAE numbers to military grade numbers, we multiply by 2 and add 1000. Hence, SAE 50 weight oil × 2 equals 100 + 1000 = 1100, the designation of the same oil in Army and Navy terms. All military grades of oil are like this except grade 1065, which is approximately the same as SAE 30 weight. In using either viscosity grade scale you must remember that as the oil gets thicker the numbers go up.

To determine the SAE rating of an oil sample, it first is tested at the correct temperature in the Saybolt universal viscosimeter. This gadget is the standard American instrument for testing petroleum products and lubricants. The tests on oils are usually made at temperatures of 100°, 130°, and 210° F. This instrument has a tube in which a specific quantity of oil is brought to the desired temperature by a surrounding liquid bath. The time in seconds required for exactly 60 cc of the liquid to flow through an accurately calibrated outlet orifice is recorded as Saybolt seconds universal viscosity. Whatever range of time and temperature this falls in gives oil its number designation. The higher the temperature and time, the higher the number classification.

The letter W occasionally is included in the SAE number, giving a designation such as SAE 20W. The W does not stand for weight but indicates that the oil, in addition to meeting the viscosity requirements at the testing temperature, also meets additional low temperature specifications for satisfactory use in very cold climates.

Although the SAE scale has eliminated some confusion in the designation of lubricating oils, it must not be assumed that this specification covers all of the important viscosity requirements. An SAE number indicates the viscosity "grade," or relative viscosity only. Both good oils and inferior oils which have the same viscosities at a certain temperature are subject to classification in the same grade. The difference would probably be in the price, if we were buying it. Just like everything else, a cheaper brand can always be had.

This is the point where the viscosity index chart comes into importance. When comparing two oils on the index chart, sample A oil may be found to have a viscosity index of 95 and sample B (also on SAE 50 oil) may have a rating of only 20. This further emphasizes the fact that an SAE rating alone cannot be interpreted as an indication of quality in lubricating oils. In general we can say that high viscosity index ratings are very desirable in all grades of oil, particularly if low temperature operation is involved.

A person usually asks for a certain oil by referring to weight. What is he actually asking for? Nothing more than the specific gravity of the oil. The gravity of a petroleum oil is a numerical value which serves as an index of the weight of a measured volume of the product.

Again, gravity is not an index to quality. It is just a convenient term for use in figuring the weights and measures of petro-

Grade Designation for Aviation Oils

COMMERCIAL AVIATION NO.	COMMERCIAL SAE NO.	ARMY AND NAVY SPECIFICATION NO.
65	30	1065
80	40	1080
100	50	1100
120	60	1120
140	70	

leum products. Specific gravity is the weight of any substance compared with the weight of an equal volume of a standard substance.

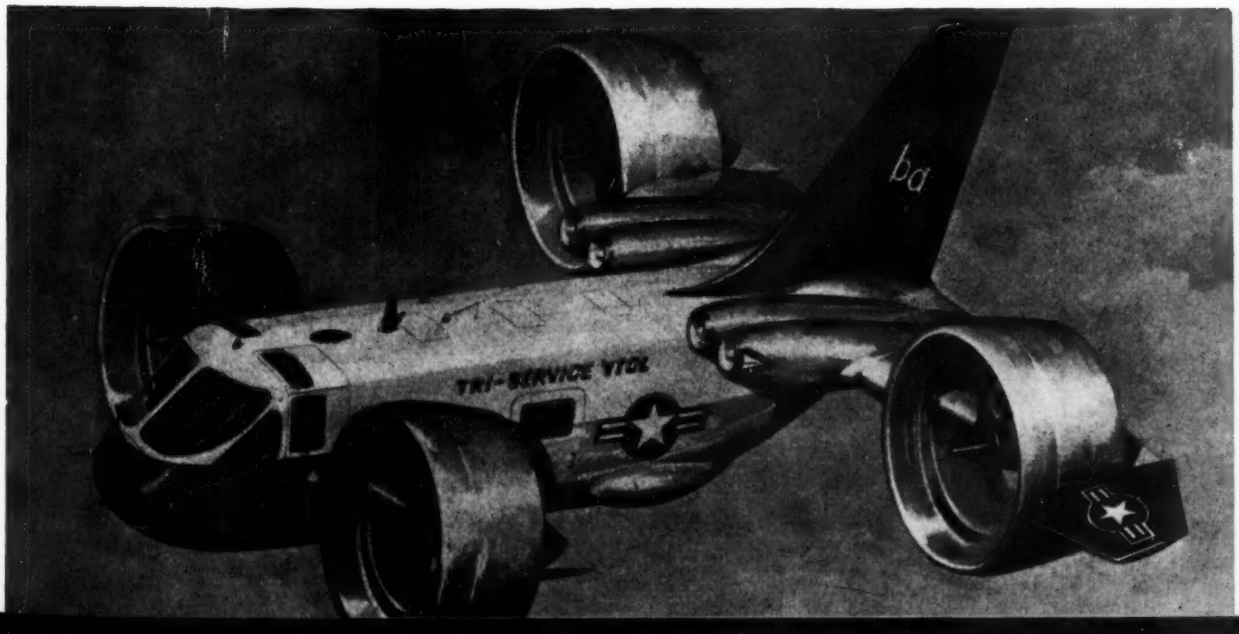
Now for the problem we may encounter when visiting our counterpart, the Air Force. There will be a problem if the aircraft you are flying consumes a great deal of oil and you did not take pains to bring your own oil. The Air Force uses detergent oil while our reciprocating engines use the nondetergent type. Well, what difference does that make? Detergents are additives which enable oils to maintain the soot, sludge, and other solid materials present in crankcase oils in colloidal suspension. Oils with detergency properties also act to remove deposits previously formed during use of nondetergent oils. If you should start using a detergent oil in place of your nondetergent, all of the soot, sludge, and other deposits that have formed in the crankcase would start breaking loose. Then what? An oil line would probably clog up at a critical moment during takeoff. This seems to be a pretty good reason for carrying a little nondetergent oil with us, especially if we are not landing at a place where we can obtain our old reliable.

Detergency, however, is not a cure-all for engine deposits, but it is important as a property for crankcase lubricating oils because it is effective in preventing coagulation and deposits of sludges on engine parts. Oils with this property not only maintain crankcase and valve chambers in clean condition, but also keep piston rings free and greatly reduce cylinder varnish formation. This all sounds like a good idea but look at the expense of just changing from one type of oil to another.

I am sure if we think a little longer we could come up with many more questions on the operation of oil in our aircraft, especially those things we want it to do to keep us flying. The books are loaded with material on this subject; don't wait until another school is conducted, so someone else will be responsible for telling you about something you need to know!

2d Tri-Service VTOL Aircraft

The newest tri-service VTOL research aircraft on the horizon is the X-22A shown above. It will be built by Bell Aerosystems Company of Buffalo, N. Y. The X-22A is a part of the tri-service program, which also includes the Vought-Hiller-Ryan XC-142 (see "The Army Aviation Story, Part V," DIGEST, Oct 1962). The X-22A incorporates four 1,250 hp T-58 engines. Two are mounted inboard of the shrouded props on each side of the rear horizontal stabilizer. The ducted props rotate 90° upward for vertical takeoff. It is expected to make its first flight in late 1965.



Fire Support Planning

Adequate fire support is mandatory if airmobile support is to be fully successful in airmobile and counterinsurgency operations.

Lieutenant Colonel Edward B. Blackman

THE COMMANDING General 55th U. S. Infantry Division, slowly turned the pointer in his hands as he listened to his G-3 and G-2 present their estimates of the situation. The latest Corps Operations Order started, "I Corps will attack with three divisions abreast —55th Division in the center, seize Corps objective ALPHA."

Finally the staff had presented to the commanding general all of the data available. Mission, weather, terrain, friendly and enemy forces—all had come in for exhaustive study. The staff were now waiting for the commander. He rose, stepped to the map board for a moment, deep in thought, then turned to his staff.

"Gentlemen, this is my concept of tomorrow's operation. The 55th Infantry Division will attack at BMNT with three battle groups abreast, 1/71 on the left, 2/72 in the center, 3/73 on the right. BG 4/74 will conduct an airmobile assault on river crossing sites, division objective TIGER, on order, assist passage of 1/71, revert to division reserve in place, prepare for commitment in division zone as airmobile reserve. Initial reserve 5/75, mechanized, will follow in zone of 1/71. Main attack in zone 1/71. Preparation will be fired. Priority of fires initially 1/71. G-3, issue warning orders; prepare the order for my signature at midnight. Have the commanders present for a briefing at 0030. Are there any questions?"

Now the staff swings into action to implement the commander's concept of the operation. One man who will drink his share of coffee wears the insignia of an Army Aviator, the division aviation officer. He will be busy tonight coordinating details of the projected operation with many, perhaps all, of the division staff.

Col Blackman is assigned to the Joint Operations Evaluation Group of the Military Assistance Command of Vietnam.

Forecasted ceilings, visibilities, and winds will be studied in detail. From the G-2, the latest weather, enemy situation, and photos of the objective area will be obtained.

A route, or several routes, to and from the objective area must be selected. Navigational aids must be sited to assist the operation. These items are to be coordinated with the G-3.

Fuel availability must be determined and resupply points established through coordination with the G-4.

Copies of the division SOI (Signal Operations Instruction) must be furnished to the helicopter units soon to be attached to the division for this operation. Coordination with the signal officer is required.

Medical evacuation plans must be coordinated with the medical officer, based on latest aircraft availability.

Location of loading zone, landing zones, RPs (release points), IPs (initial points) all are to be coordinated with the combat support section commander supporting the 4/74.

LOs (liaison officers) from the supporting helicopter units must be met, briefed and provided guides to the 4/74.

Maps must be obtained from the Engineer.

These are a few of the many details of staff coordination which must be accomplished. Is anything missing? Yes, one main item is still to be coordinated: fire support for the projected mission has not yet been considered.

FIRE SUPPORT MEANS AND CONSIDERATIONS

The details listed above are essential to this or any similar operation. But the operation would have been in vain if the assault troops failed to reach the objective. The most important act to help ensure that the objective is reached is the proper planning for the fire support needed before and during the assault as well as during any subsequent withdrawal phase.

Fire support of helicopter operations can be classified as *offensive, suppressive,* and *defensive.*

Offensive fires are those placed along and adjacent to the flight plan route and on the objective to destroy or neutralize known enemy positions. Timing of these fires would be prior to passage of the heliborne forces.

Suppressive fires are those fires placed along and adjacent to the helicopter flight route and on the objective to prevent the enemy from bringing effective firepower on our aircraft. Known and suspected hostile positions are brought under fire until passage of the heliborne forces. These fires are timed to be executed during the passage of the helicopters and immediately prior to landing on the objective.

Defensive fires are those fires on the target after it has fired on our helicopters. Suppression or destruction is the objective of these fires; however, the enemy has already accomplished his objective if he has placed effective fire on one or more aircraft.

To some degree all or part of the foregoing fires may be delivered by artillery, missiles, fighter-bomber aircraft, armed helicopters, and weapons mounted on the transport helicopters.

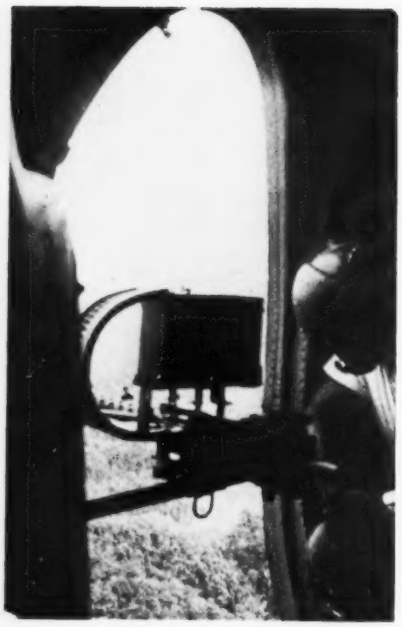
Ideally in heliborne operations, fire support means should be available to accomplish all three types of fires. A combination of surface weapons, high performance aircraft, and armed escort helicopters would be ideal. The suppressive and defensive fire support means must be immediately responsive to the helicopter force commander, and he must have reliable communications free of delays, such as those caused by language barriers. A high degree of teamwork is required for this type of fire support.

The least effective firepower available to the helicopter force commander during his flight to the objective is that which is mounted on his transport helicopters. Pilot controlled weapons firing forward cannot be employed on the flanks without major changes of direction by individual aircraft and subsequent disruption of control over the formation of the transports. Side-mounted weapons have only a limited time in which to detect and engage a target due to the relatively high airspeed and low altitude of the flight.

Due to time-of-flight delay and necessity of more lengthy target designation, the next least effective firepower for suppressive and defensive fires is surface-to-surface firepower. Preplanning and timed fires can improve this effectiveness to some extent, but the exact timing required for effective suppressive fires to be on-target during the passage of the helicopter column is difficult to execute.

More suitable are the fighter-bomber aircraft; however, they do have several limitations. The first is their relative inability to "sit" on a target and place accurate continuous fire on it until the helicopters have passed; the second limitation is the difficulty in designating a target to the fighter-bomber pilot. (This varies. If the pilot is U. S., it is easier; if Allied, it becomes more difficult due to language barrier.)

The most effective fire support means for *suppressive* and *defensive* fires are armed escort



helicopters having a speed capability equal to or better than that of the transport helicopters. They possess the ability to live, work, and fight with the transport helicopters. Their greater agility should permit them to sit on target for longer periods of time, while the transports are moving through a hostile area. Their firepower should be sustained, not a one or few shot deal such as with a rocket-equipped helicopter. For this reason the light machinegun-equipped helicopter is preferable for escort, unless hard targets are definitely expected and must be reduced rather than bypassed.

For *offensive* fires on the objective and in preparation for the helicopter movement, the fighter-bomber holds an advantage over the armed helicopter because of its speed and greater ordnance carrying ability. The armed helicopter has the advantage of being able to move into the objective area and of remaining to provide offensive on-call fire support to the ground forces.

FIRE SUPPORT PLANNING CONSIDERATIONS

The aviation officer will present his requirements and recommendations to the FSE (Fire Support Element) in the TOC (Tactical Operations Center) so the Fire Support Plan may be prepared. (We will assume all planning is conducted within the TOC.)

First, target location: all known, suspected, or probable points of enemy resistance to the helicopter column must be identified and evaluated. Which positions must be neutralized to assure safe passage? Which positions must have suppressive fire to assure safe passage?

After location, what are the means? Conventional artillery, missiles, fighter-bombers, armed escort helicopters, and defensive armament on the transport aircraft themselves must be evaluated for strengths and weaknesses and each means applied against specific targets. Lack of sufficient means will require establishment of priorities, a change of route, or both.

Battery and battalion relocation may be dictated because of masking of some fires by aircraft movement or to remove range limits on a specific target. The air corridor requirements must be established early, and provisions made for preventing friendly fires from endangering the movement of friendly helicopters.

What preparation will be required in the objective area? Scheduled fires may so alert the enemy as to lose any advantage of surprise offered by the helicopter assault. Lack of preparation may find the objective too strong for the assaulting troops.

TRY IT YOURSELF

How detailed have fire support annexes been prepared on your recent CPXs and FTXs involving airmobile operations? It is suggested that a full fire support annex be prepared to cover *offensive, suppressive* and *defensive* fires for your airmobile operations. It will keep you awake and will be interesting as well as educational to all concerned.

It is absolutely certain that fire support planning is a MUST for any airmobile operation against an actively organized enemy. There is little doubt that we will incur operational losses to enemy fire during airmobile operations. These losses can be kept at an acceptable level only if we fully use all available firepower to reduce the enemy capability.

FIRE SUPPORT, AIRMOBILE, COUNTERINSURGENCY OPERATIONS

So far we have discussed "Fire Support Planning for Airmobile Operations," stressing the importance of providing adequate fire support for airmobile operations. The one basic assumption made was that United States Forces had the capability to deliver firepower in whatever form we desired, to a location of our own choosing, at a time most advantageous to our plans. Now we will cover the particular problems inherent in a counterinsurgency operation when limitations have been placed on our employment of firepower.

REASONS FOR LIMITATIONS

The only situation under which U. S. commanders might have an unrestricted capability to employ any and all fires in counterinsurgency operations is within our own national boundaries. Under these conditions, the commander might retain sole responsibility for the positive identification of insurgents and be able to exert his forces freely in the counterinsurgency role.

In all other situations a limitation to some degree will be placed on United States capabilities by the allied sovereignty within whose territory United States Forces are deployed.

This limitation of our capability to exert combat power in counterinsurgency is brought about by the very nature of the guerrilla. The guerrilla fighter can be generally placed in one of two categories.

In the first category is the guerrilla who comes from an ethnic group different from the local population. He might differ in color of skin, language, features, or cultural background. The Far East is a good example of this possibility; there the Vietnamese, Thai, Chinese, Malayan and Burmese might mingle in the same crowd. Untrained Western eyes can detect little difference and cannot make a positive national or racial identification; the local populace normally can readily identify the various groups.

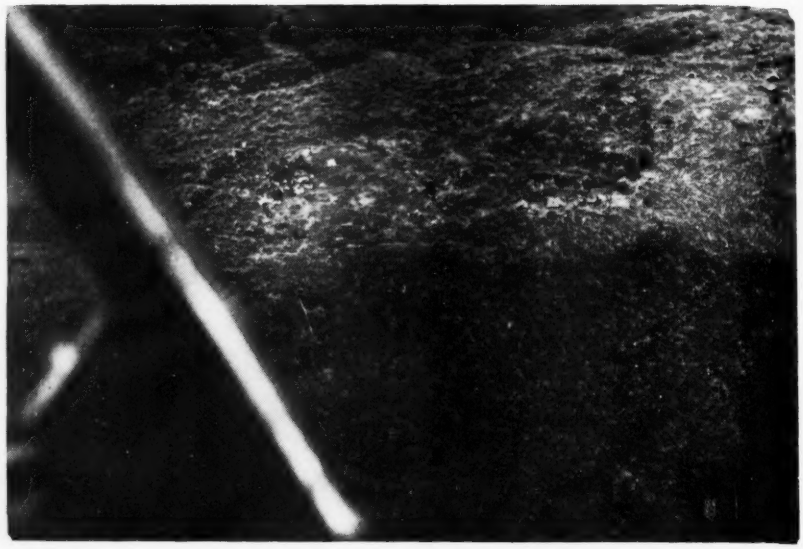
In the second category the guerrilla is an integral part of the local population and cannot be readily identified through obvious differences. The only positive identification is when he is actively engaged, weapon in hand, on guerrilla operations, and he has but to rid himself of the weapon to become unidentifiable. His operations resemble those of a submarine as he operates hidden beneath the surface of the local population, surfacing only to give battle, then disappearing again.

These two categories compose the guerrilla forces. The first category includes the "volunteers" to assist the local effort, the cadres, the leadership and/or

advisors supplied by the nation sympathetic to or directing the guerrilla action. The second category is formed of locally recruited talent, the "outgroup," the man of whatever political cast who is opposed to the present national government, and is much more effective in his operations.

Taken together, the active guerrilla forces compose only a small percentage of the total population within which they operate. The bulk of the local population may be (actively) in sympathy with the guerrilla effort; it may be forced through coercion and terror to provide support to and remain silent about the local guerrilla bands; or it may actively participate against the guerrilla, refusing him support and informing the national government of his moves. Only the latter condition is conducive to successful counterinsurgency operations.

Thus, as always, the objective of warfare is to capture the minds of men, whether it be in general war, limited war, counterinsurgency, or a mixture of these. In counterinsurgency, the



sovereign power within whose nation United States Forces are deployed or assisting will be most sensitive to the need to retain the support of the loyal population and will exert every effort to gain the loyalty of dissident and neutral portions of the populations. Thus, it is readily apparent that sovereignty must, in its own self-interest, place limits on the combat capabilities of United States Forces to prevent or at least to control its impact on the noncombatant bulk of the population.

FIRE SUPPORT PLANNING FACTORS, CI OPERATIONS

Two primary differences exist between the fire support planning of airmobile operations during conventional warfare and airmobile operations during CI operations. The first difference will exist in the limitations placed on use of our combat power. The other difference lies in the basic tactics and techniques of the insurgent.

Offensive fires will rarely be used. Guerrilla positions are not normally static and do not offer a fixed target. Secondly, such fires would endanger the nonparticipating bulk of the population to a degree unacceptable to the host government. Any offensive fires should be either under the direct control of or by the expressed consent of the host government.

Thus, primary reliance must be placed on suppressive and defensive fires. The most important consideration for the application of these fires is that the enemy must be positively identified.

As in conventional fire support planning, all or part of the foregoing fires may be delivered by artillery, missiles, fighter-bomber aircraft, armed helicopters, and weapons mounted on the transport helicopters. However, the fluidity of counterinsurgent operations and the rapid reaction required by the supporting firepower will normally preclude surface-to-surface delivery means. Of the remaining means of delivering firepower, the armed escort helicopter is the most effective.

Adequate fire support is mandatory if airmobile support is to be fully successful in counterinsurgency operations. Only through full understanding of its many uses and limitations can the commander fully exploit this new tool of war.

crash sense

PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

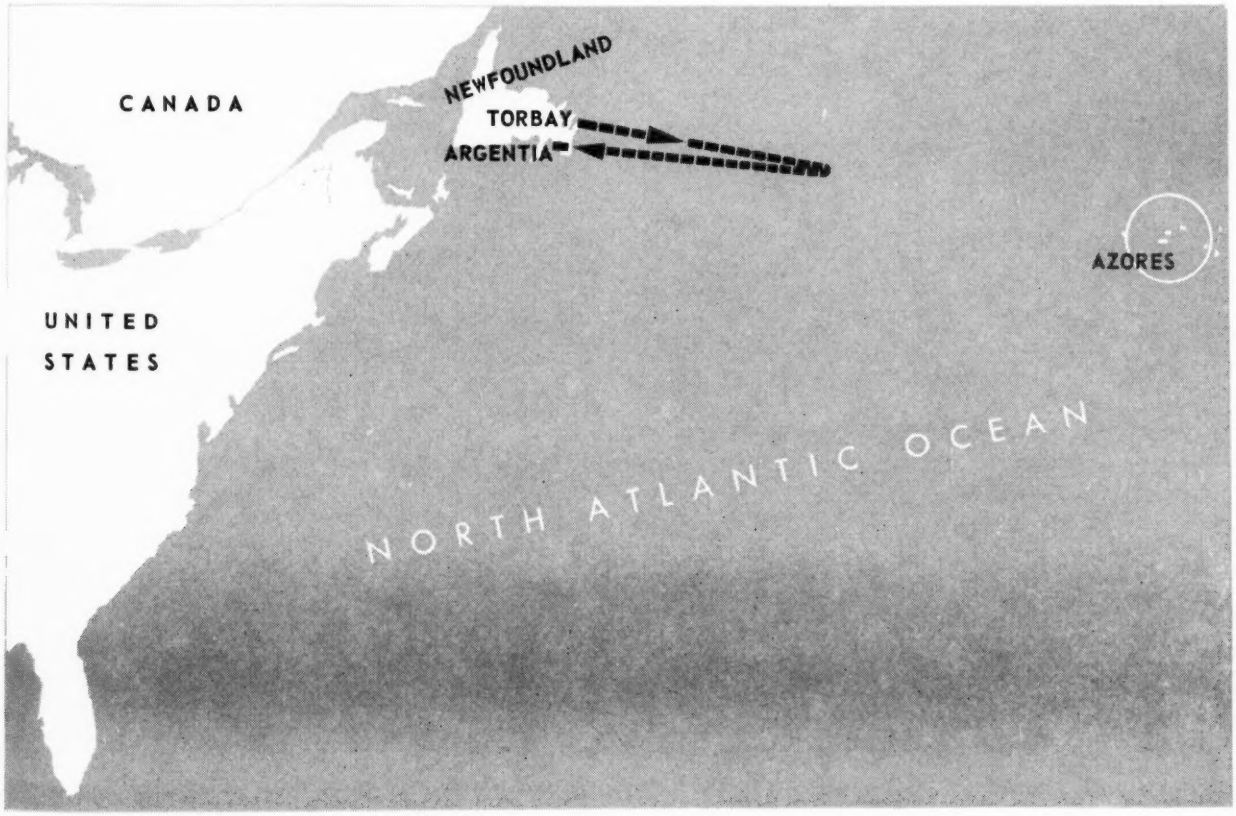
Point of No Return

SCHEDULED TO ferry a U-8F overseas, the crew of flight commander and copilot/navigator arrived at the flight operations division to begin processing. A message was prepared requesting en route clearances, briefing for the crew at McGuire Air Force Base, escort aircraft service, estimated dates of departure and arrival for each country as required, etc.

The flight commander, obviously anxious to get away, stated that he didn't feel that all the clearances and preparations were necessary or required. Despite his objections, preparations for the flight were completed in accordance with the U. S. Air Force Foreign Clearance Guide.

After the message had been completed, the flight commander informed the flight operations division that he would be several days late for the McGuire AFB briefing and several days late en route to each country. Since 72 hours is maximum leeway for some countries, the message had to be changed to give the flight commander time to conduct his business en route. A date of———1962 was established as an acceptable departure date from McGuire AFB to accommodate the flight commander.

The U-8F left St. Louis six days before the scheduled departure date from McGuire AFB. Four days later, TMC



flight operations division received an RON message stating that the flight crew arrived and departed McGuire AFB two days early.

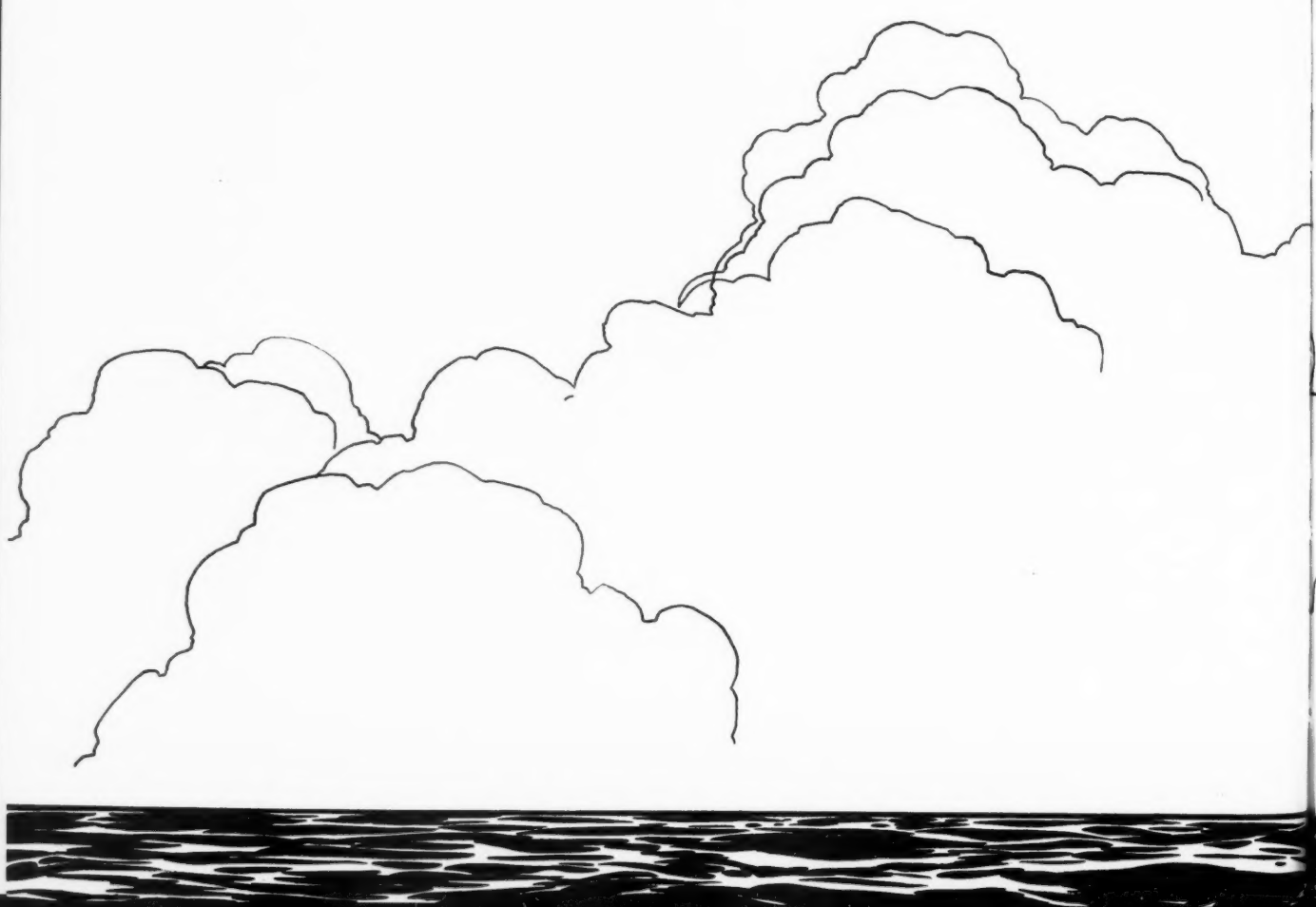
The early departure from McGuire caused the aircraft to reach Torbay two days before the scheduled departure for the first leg of the overseas flight to the Azores. Again showing signs of impatience, the flight commander "pestered" (the operations officer's word) the operations officer of the 54th Air Rescue Squadron into setting up escort aircraft for an earlier departure. Though it was against established policy to provide an escort for one aircraft, the operations officer was able to provide an escort and the flight was scheduled for takeoff at 1100Z the following morning.

Prior to takeoff, the weather worsened — surface winds 58 knots, low ceilings, icing at altitude, and unfavorable winds en route. The Air Force operations officer recommended the flight be postponed because of the weather. But the U-8F flight commander insisted on going.

An HC-54 was scheduled for takeoff to escort the U-8F to ocean station Delta. The HC-54 lost an engine on the runway and aborted. The operations officer then advised the U-8F flight commander that there would be a delay of 2 hours and 45 minutes for another escort aircraft. The flight commander again insisted on going, but reluctantly agreed to wait.

When the HC-54 arrived over Torbay for the escort at 1536Z, the crew found that the U-8F had taken off an hour and 15 minutes earlier, *without notifying the 54th Air Rescue Squadron.*

The HC-54 managed to catch the U-8F short of ocean station



Delta, just as another HC-54 from the Azores arrived to pick up escort responsibility. Approximately 60 miles southeast of ocean station Delta, the U-8F flight commander declared insufficient fuel for the remainder of the flight to the Azores and turned around, heading back to Newfoundland. The first HC-54 then resumed escort.

As the U-8F turned back, Torbay reported a 100-foot ceiling. The Royal Canadian Air Force, the Coast Guard, and shore facilities were alerted during the last three hours of the inbound flight.

Torbay was socked in as they reached the coast, but the weather over Argentia — 60 miles across the peninsula — broke to 1,500 feet long enough to let them get in.

THE DD FORM 175 FOR THIS FLIGHT INDICATED 10 HOURS FUEL ABOARD. OFFICIAL RECORDS SHOW THAT THE AIRCRAFT FLEW 9 HOURS AND 56 MINUTES!

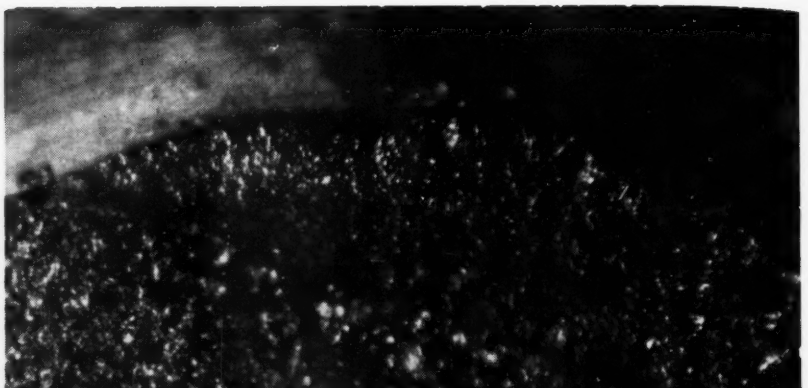
Three days later, favorable weather allowed completion of the ferry flight without further incident.

As you may well imagine, the correspondence that resulted from this flight (from which this account was drawn) is not favorable to Army Aviation. Among other things, the air rescue service expended 54 hours of HC-54 flying time for this ferry mission. In the words of one reviewing official, ". . . it appears that this is a case of stubbornness and refusal to listen to wiser and more seasoned advice based on actual experience. Incidents such as this are bound to leave a bad taste in the mouths of all. . . ."

MAINTENANCE

As the moon appeared over the horizon on a warm dark

Aircraft crashed in left bank attitude



Greatly enlarged cross section shows area of fatigue

night, a flight of four CH-21s in V formation were returning to their unit airfield. Suddenly, the lead aircraft was seen to pitch up. It slowed rapidly and the other aircraft of the formation closed and passed it as it rolled to the left and fell. From 1,400 feet, the Shawnee wallowed to the ground and crashed in a left-bank attitude. The aircraft was destroyed by the crash impact and all seven aboard sustained fatal injuries.

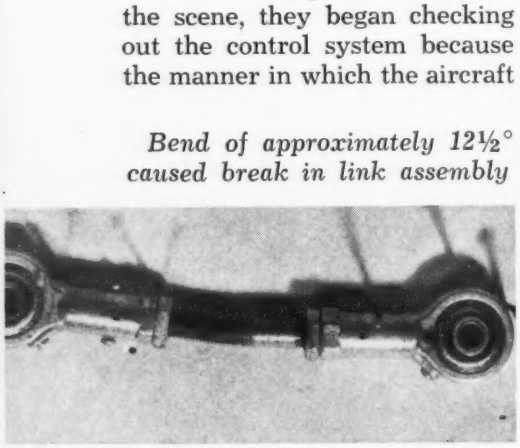
When investigators arrived on the scene, they began checking out the control system because the manner in which the aircraft crashed indicated a control malfunction. Removing the access panel to the Christmas tree, they found the link assembly (P/N 22C-1028-3) which attaches to the output of the longitudinal cyclic servo broken. The assembly was taken to the laboratory for analysis. Here, the break was determined to be fatigue failure, caused by a slight bend in the link assembly. A partial check of the other CH-21 aircraft in the unit brought to light four more defective link assemblies.

As a result of TMC message SMOSM-ECH-21-02-1327, dated 6 February 1963, another unit inspected three CH-21s and found two link assemblies which were cracked in the riveted end of the rod end bearings. These cracks were not visible to the naked eye, but were detected through magnaflux.

The link assembly is designed with an ultimate strength of 4,010 pounds of compression or tension forces. In normal operation, the link assembly is subjected only to compression and tension forces, and maximum normal loads never exceed 194 pounds. But the link assembly is not designed to sustain lateral forces, and 100 pounds of lateral force is enough to cause the link to bend. Once bent, the normal compression and tension forces are multiplied many times and can cause fatigue failure.

It could not be determined when the link assembly was bent. However, it is likely that this occurred during maintenance, as this would be the only time the access panel would be removed to service the Christ-

Bend of approximately 12½° caused break in link assembly



mas tree area. According to the maintenance records of this aircraft, the last periodic inspection was made 59 flying hours before the accident. No evidence could be found that the access panel had been removed for any reason since that time.

During maintenance and/or inspections of the Christmas tree area, it is necessary that tools be inserted in the area of the link assembly. Here, it only takes one slip of a socket wrench, a screwdriver, or any other tool to slap a hundred pound lateral load on the link assembly. When this happens, the bend may be so small that it will go unnoticed, yet of enough magnitude to start a fatigue failure as normal tension and compression loads are applied.

The best prevention for this condition rests with maintenance personnel. Extreme care should be used to see that no tool or any other object comes in contact with the link assembly. In the event a tool does slip and strike this part, you should never rely on your eyesight to determine whether it was damaged. Take it out and check it. If there's any doubt about it, replace it.

While the investigators were probing the cause of this accident, another CH-21C crashed nearby under circumstances that indicated control failure. Arriving at the scene, they found a bolt (P/N 22C1700-1) missing from the aft lateral cyclic bell crank (P/N 42C1676-4). As of this writing, the bolt has not been found. The bell crank and rod end showed no evidence of the kind usually associated with bolt failure. It is considered probable that the bolt was lost because: (a) it was not safetied; or (b) the bolt head snapped off and the bolt vibrated out.

Extreme care needed for work in Christmas tree area

A check of 15 bolts from the other aircraft of this unit found three defective bolts with minute cracks in the area between bolt head and shank.

At this time, it has not been determined whether the bolts were manufactured with defects, whether they were damaged before installation, or whether they were overtorqued. Properly installed, the only forces acting on this bolt are on the shank of the bolt from the rod end and bell crank. Overtorquing can place a stress on the bolt head and must be avoided.

ECHELON RIGHT

The UH-1B struck a 40-foot pine and crashed through the trees. Initial ground impact was made at an 18° angle. An oak snag 14 inches thick ripped across the floor of the aircraft, all but tearing out the copilot's seat. The Iroquois rolled to the left, hit the ground again, skidded 7 feet, bounced, rolled, and came to rest in an inverted position.

Of the nine aboard at the time of the accident, one passenger sustained critical injuries, the pilot and another passenger

Aircraft came to rest inverted

sustained major injuries, and the crewchief sustained minor injuries. The aircraft was destroyed.

The mission called for two UH-1Bs to pick up passengers from a loading site, fly a left-hand circular pattern and land on opposite ends of the roof of a 300-foot high building.

Here is the pilot's description of what happened:

"We took off in a trail formation. I was in the number two position. We took off to the north proceeding to . . ."

"We made one turn to the west and were flying in a circular pattern to our dropoff point. I was flying high and to the right rear of the other ship. We were making calls on takeoff and on our turn from base to final.

"The lead aircraft called on his break for final. I would say that my airspeed was approximately 70 knots [at that time]. We were about 150 feet up when I started to look for my checkpoints. I was hunched over trying to pick up the points.

"The next thing I knew, the crewchief [in the copilot seat] told me we were closing in on the lead ship and I righted the ship to take a look. I then exercised a hard right turn and at this point I saw that I was less than a rotor away from the side of the lead aircraft. I was still high and to the right of the lead aircraft but had closed in much more than I had ever been to another aircraft before. Then I gave it a hard right and the ship turned up and slipped off to the right.

"I made the right turn in an attempt to break away from the lead ship to prevent hitting him. After I made the sharp right turn, the ship began to lose altitude. As I tried to straighten it out, it was just dropping into the trees. . . ."

"The movement to the right was very fast and very hard, and it was the first time that I had ever done that. The ship was slipping and I was trying to get it back. I would say that I was less than 100 feet above the trees when I made the movement. . . ."

"After I made the hard right turn, I do not remember any vibration, but I do remember a shuddering."

The cause of this accident is obvious to anyone who has ever flown formation. The one cardinal rule for formation flying that must never be broken is: KEEP THE LEAD AIRCRAFT IN SIGHT EVERY SECOND! It's physically impossible for the pilot in the right seat of any side-by-side cockpit to follow this rule while flying echelon right in a left turn. If echelon

Pilot's helmet prevented probable fatal head injury

right is required, a qualified pilot should always be in the left seat. If another qualified pilot is not available, echelon right should not be attempted.

This accident serves as another testimonial to the lifesaving qualities of the APH-5 helmet and seat belts.

WHO'S ON FIRST?

The Accident

A UH-19D, with pilot, copilot, and six passengers, landed at a civilian airport to refuel. The aircraft was stopped in front of two gas pumps, with its left side parallel to and beside the pumps. Since the gas filler ports were on the right side, the pilot (copilot?) started moving the aircraft forward in an attempt to get closer to the pumps, as the refueling hose did not appear to be long enough to reach the filler ports from the original position.

An aluminum stepladder beside the gas pumps was blown over by the rotorwash. The main rotor blade tips then struck a metal sign suspended from pipes attached to the pumps. The tip caps were torn off and the sign fell toward the aircraft so that it was struck by one of the main rotor blades approximately 3 feet inboard from the tip. The blade was bent and the damper and pitch change rod broke, causing the blade to lag behind its usual position and resulting in an extreme out-of-balance condition.

The aircraft entered a violent vibrating and bouncing motion. The tail cone was broken off just behind the cabin area and the battery came loose. The pilot (copilot?) and copilot (pilot?) sustained minor injuries as they were flung around in the cockpit by the violent motion of the aircraft. The six passengers escaped injury.

Here is the statement of the pilot (copilot?) who was riding in the left seat:

"Mr.——[the occupant of the right seat] made the takeoff and then I took the controls. I landed on the taxiway parallel to runway 31. We landed in a path that made a 30° angle to the right of center of the taxiway so that we were more into the wind.

"I then taxied up to the pumps and stopped with our left side nearest to the pumps. The gas hose did not look like it would reach, so I started again, straight forward and parallel to the pumps, with the intent of turning more to the left to get closer once we passed the sign.

"I started forward, then Mr. ———said, 'Watch the ladder,' which was being tossed away from the helicopter by its rotorwash. Then he said, 'Watch the sign.' Then all three blade tips hit the sign.

"I don't remember any cyclic feedback right away, but I do remember cutting the throttle and pulling on the rotor brake. The sign fell forward toward the chopper and one blade hit it solid. For a few more revolutions, the rotor turned smoothly, then suddenly the blade seemed to droop, the horizon changed its apparent position, and the helicopter started vibrating and bouncing violently.

"I don't know who had the cyclic when I pulled the [rotor] brake. When the aircraft stopped bouncing, I noticed Mr.——— holding his head. I asked him if he was OK. He did not answer the first time, but when I repeated the question he said he was OK except his shoulder and head hurt. I then climbed down and checked on the passengers. They were OK, so I asked a doctor, who was one of the pas-

Chickasaw lost battle with metal sign

sengers, to check Mr. ———. An injury to my left hand hurt and made me conscious of the fact that I was hurt, too."

Question: "When were you assigned the flight?"

Answer: "The night before."

Question: "Who was assigned as pilot?"

Answer: "I don't know; it was listed as Mr. ———— and myself."

And here are portions of a letter from a reviewing official:

" . . . it appears essential that a command policy, understood by all, be made to require the pilot (or pilot in command) to sit in the pilot's seat and not be elsewhere in the aircraft. The normal practice is for aviators to rotate positions in an aircraft to relieve one another in the capacities of pilot and copilot and passenger, if more than two. Complying with paragraph 3, AR 95-2, under these circumstances is easy—the aviator performing duty as first pilot is in command of the aircraft. When he changes to another seat he is no longer the first pilot and no longer in command. If a unit commander desires to name one individual as in command of the aircraft for the entire flight, it would seem reasonable to require that individual to log first pilot time and sit always in the pilot's seat.

". . .A review of the definitions of pilot and copilot in paragraph 3, AR 95-4, makes it clear that the pilot of an aircraft can only serve in this capacity from the seat in the aircraft designated for the pilot and that the copilot can only act as an assistant to the pilot by occupying the copilot's seat. The function of instructor pilot, which [occupant of right seat] happened to be, is not a factor to be considered since [occupant of the left seat] was not being given instruction in the aircraft."

The question remains: Who's on first?

Survival And Flight Equipment

INTERESTED IN improved survival and flight equipment? You might qualify to become a member of SAFE, an organization dedicated to this purpose. SAFE collects and dispenses nonproprietary information about survival and flight equipment. This includes new equipment, procurement sources, maintenance and repair methods, and many other items of general interest.

Membership is open to all persons with an interest in improved survival and flight equipment. There are two grades of eligibility for membership in SAFE. Grading consideration is determined by experience level, job activity, contact with aircrew members, and responsibility for equipment.

SAFE was founded in 1956. Pete Barker of North American Aviation was responsible for getting the organization off the ground. Eight representatives of four major aircraft contractors were present at the initial meeting. Increased interest brought about the formation of an east coast branch in 1959. Total membership now exceeds 30 members. A monthly "Newsletter," edited by Bob Minner of Hughes, disseminates valuable information to members.

Ed Campbell, Grumman Aircraft Engineering Corporation, Bethpage, Long Island, New York, is program chairman for the east coast branch of SAFE. He should be contacted for application blanks and further information.

Meetings are conducted once a month and members share responsibility for educational programs. A portion of each meeting is reserved for general discussion, usually centering around problems of individual members.

Aircraft contractors who have members in SAFE are Boeing, Chance Vought, Convair, Coleman Engineering, Douglas, Hughes, Lockheed, North American, Northrop, Republic, and AVRO; the Air Force is also represented. The east coast branch includes representatives of Grumman, Martin, Kaman, Republic, and various military installations in the New York City area. Frank Jagger, known in Army circles for his association with the Martin-Baker ejection seat, is vice president of SAFE for the east coast branch.

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR MILITARY OPERATIONS
WASHINGTON 25, D.C.

MEMORANDUM TO ALL PERSONNEL IN THE ARMY AVIATION PROGRAM:

During the past year and a half, I have considered it an honor to serve as Director of Army Aviation. It has been one of the most stimulating assignments of my career.

As I depart this station for a new assignment, I would like to extend my best wishes for a continued successful program to Army Aviators around the world. It has been a real pleasure to have your support and to work with you.

Even though I will no longer be the Director of Army Aviation, my interests will remain with the program. I will look forward to receiving the U. S. ARMY AVIATION DIGEST each month to help keep me abreast of Army Aviation. The DIGEST serves as an important force in the overall aviation program.

DELK M. ODEN
Brigadier General, GS
Director of Army Aviation, ODCSOPS

SO I TOLD THE OLE MAN... I'VE BEEN CREWING THESE BABIES FOR YEARS...
HE THINKS YOU HAVE TO GO BY THE BOOK ON EVERYTHING,
WHY I COULD OVERHAUL A B-36 WITH A PAIR OF PLIERS AND A SCREW DRIVER
BACK IN THE OLD DAYS, IN THE BROWN SHOE ARMY AIR CORPS,
YOU HAD TO HAVE THAT OLD DRIVE... IMPROVISE!
WE GOT ALONG WITHOUT TORQUE WRENCHES THEN...
SO I TORQUED IT DOWN WITH MY CALIBRATED ARM...
WHOEVER HEARD OF OVERTORQUING A PROP DOING ANY DAMAGE ANYWAY?